ARCHIVES OF OPHTHALMOLOGY.

OBSERVATIONS ON THE MACULA LUTEA.

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HISTOLOGY OF THE HUMAN MACULA (*Continued*).

C.—THE MEMBRANA LIMITANS EXTERNA.

THE older writers describe the membrana limitans externa as a true membrane; later authors consider it a fenestrated membrane; my observations however tend to show that neither of these views is correct. No membrane separates the bacillary from the outer granular layer, but coarse fibres run parallel to the plane of the retina intertwining with the basal portion of the rods and cones, just as the weft of a fabric interlaces the warp, forming a supporting tissue for the bacillary layer.

If we examine the vertical sections illustrated in Figs. 15 to 20 we find that in thin sections the membrana limitans externa appears as a straight rouletted line, which is the appearance that interlaced fibres have when viewed vertically, and this is confirmed by transverse sections as shown in Fig. 23, which is taken from a section only slightly oblique, so that three or four rows of these stout intertwining fibres can be seen.

The so-called membrana limitans externa is invariably a straight line when seen in vertical sections. Whenever it appears wavy it is due to shrinkage of the specimen. It is this straight line formed by the intertwining fibres which has hitherto been regarded as the section of a membrane. Transverse sections now show us the real structure. There are only two membranes in the retina, the membrana limitans interna and the membrana terminans, the latter contigu-

ous with the choroidal membrana vitrea (membrane of Bruch) as I previously described. Between these two membranes the retina lies as an uninterrupted structure.

D.—THE OUTER GRANULAR LAYER.

Before discussing this layer I think it necessary to repeat, what I said in my last paper, viz.:—that my observations led me to believe that the ultimate optic nerve fibrils run continuously from the optic nerve to the spherules in the hexagonal layer. I not only find this confirmed by subsequent observation, but I further find two distinct forms of nerve fibrils in every layer of the retina, and even in the optic nerve itself. These two kinds of nerve fibrils can be distinguished by their mode of insulation and can be traced to the cones and rods respectively. I shall therefore refer to them as "cone-fibrils" and "rod-fibrils."

The cone-fibrils are protected throughout their entire course from the optic nerve to the spherules in the hexagonal layer by sheaths. The so-called Müller fibres, as Borysiekiewicz[1] has already pointed out, are not sustaining fibres, but merely the continuations of the cone-sheaths. In these sheaths the cone-fibrils lie embedded in a protoplasmic substance, supported by radiating fibrillæ. The rod-fibrils are insulated in various ways in the several layers and are not surrounded by this protoplasmic substance.

It suggests itself to me that the protoplasmic mass in which the cone-fibrils are embedded in the sheaths may be a transparent modification of the white substance of Schwann. If this is so, opaque nerve-fibres may be due to this high differentiation of the white substance of Schwann being arrested during development.

I am further inclined to believe that we may regard the cone-fibrils as the axis-cylinders of specialized medullated nerve-fibres. These axis-cylinders are surrounded by the above mentioned modified form of the white substance of Schwann surrounded by sheaths which are likewise differentiated, being transparent, and without the nodes of Ranvier.

[1] *Weitere Untersuchungen über den feineren Bau der Netzhaut.* Wien, 1894.

If we consider the cone-sheaths, their contents, and the fibrils in their midst, as constituting specialized medullated fibres, we must regard the rod-fibrils as non-medullated fibres, likewise specialized and variously insulated. In the bacillary layer as shown in Fig. 11 and Fig. 12 the axis-cylinders of these non-medullated fibres run through a sheath, but are not surrounded by the modified substance of Schwann.

In other words we might substitute the terms medullated and non-medullated fibres for cones and rods respectively.

I may here mention that in the optic nerve and the inner layers of the retina I meet with a third form of nerve fibres which seem to me to belong to the sympathetic system, and these can be traced to the retinal blood-vessels and capillaries.

In the preparation of the retina for microscopic examination the protoplasmic mass contained in the sheaths which bear the cone-fibrils frequently coagulates, and contracts under the influence of reagents so that nodules are formed which stain darker than the rest and vacuoles are formed. These nodules and vacuoles have been considered normal and consequently misinterpreted.

The ultimate nerve-fibrils, both the cone-fibrils and those connected with rods, are exceedingly fine, varying from 0.1μ to 0.3μ and therefore can only be seen with very high magnification. As specimens prepared by the Ramon y Cajal and Golgi methods are of necessity thick, and have usually to be examined without a cover slip, they will not bear more than 100 to 300 diameters magnification, and therefore these very fine fibrils cannot be seen in specimens prepared by these methods.

It appears to me that what has been described as revealed by these methods are the nerve sheaths and the sustaining networks, and that frequently the stain has run into and between the meshes of the network, giving rise to those remarkable appearances of which other methods do not reveal the slightest trace.

It is only by methods which admit of very high magnification that the course of such an infinite number of minute

nerve-fibrils can be traced through the neuroglia and other insulating and sustaining structures. It is only by means of the most recent methods and appliances that sufficiently perfect sections can be obtained, and I have moreover found microphotography of the very greatest assistance. Microphotography not only reproduces what we see, but it enables us to compare successive fields of view in a manner which is impossible by any other means.

The outer granular layer (of which a transverse section is represented in Fig. 21) consists of a network, in the meshes of which the granules characteristic of this layer are suspended, and through which the prolongations of the cone-sheaths, the so-called Müller fibres, run. The section through these Müller sheaths and their protoplasmic contents stain dark, and appear in the photograph as irregular patches. Any doubt as to these irregular dark patches—shown in Fig. 21—being actually transverse sections of the sheaths which bear the cone-fibrils, has been removed from my mind by the appearance presented by very oblique sections through the layer, and I therefore subjoin a microphotograph of such a section in Fig. 22. This section having been obtained in the macula region, the sheaths are numerous, and close to one another. I have specimens of transverse sections in which the knife has removed the hardened nerve-fibril from the centre of its protoplasmic surroundings, so that a small round space can be seen in the centre of each of the Müller sheaths.

On closer examination of the granules we find a rod-fibril passing through the centre of each, and we can see the radiating fibrillæ which hold it in position. These granules are filled with a granular mass which affords additional insulation to the nerve-fibrils suspended in their centre.

In vertical sections the rod-fibrils can be traced through each successive granule, so that we may picture each of these ultimate nerve-fibrils running through the granules like a string threaded with beads.

The granules of the outer granular layer, though slightly smaller, resemble in structure the spherules in the hexagonal

FIG. 23.

Transverse section through a few granules x 3000 diameters. The nerve fibril in the centre and the radiating supporting fibrillæ embedded in the granular substance which fills the granule can be clearly seen.

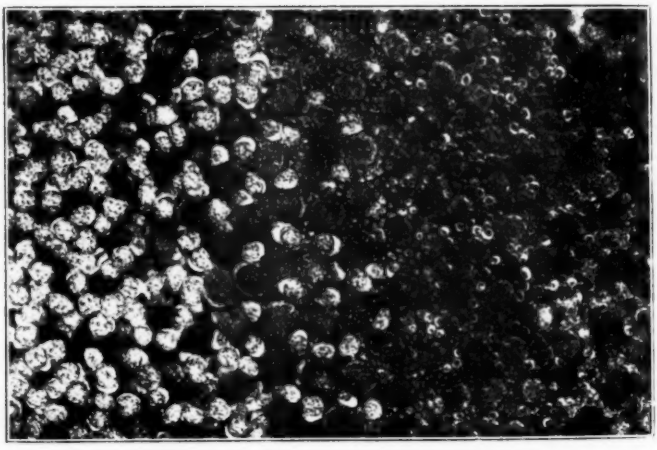

FIG. 24.

Transverse section (slightly oblique) through the basal portion of the bacillary layer and the outer granular layer x 1000 diameters. This figure shows on the right-hand side the rods and cones, on the left, the outer granular layer. Between the two, in the centre of the picture, we see the cone-bases and the large granules, and intertwining these the coarse fibres of the membrana limitans.

layer, as will be seen from the microphotograph shown in Fig. 23, which represents a few granules magnified to the same extent as the spherule in the hexagonal layer depicted in Fig. 10.

In addition to the granules which support the rod-fibrils, other large granules are situated in the thickened portion of the Müller or cone-sheaths on the inner side of the membrana limitans and in close contiguity with it. The Müller sheaths attain their greatest width at the limiting membrane; outwards they taper off very gradually to form the base of the cones, inwards they narrow rapidly after having enclosed the above mentioned large granule. As the membrana limitans externa consists, as I have said, of stout fibres which entwine the base of the cone-sheaths just outside the point where these large spherules lie, we would expect it to be visible in slightly oblique transverse sections between the bacillary layer and the outer granular layer encircling cone-bases or large spherules. Such is in reality the case, as will be seen in the microphotograph, Fig. 24.

The section represented in that photograph is taken from the outer papillary or fourth area; there the cones are much more numerous, and much smaller in diameter than in the peripheral area; therefore the bacillary layer appears different from that represented in Fig. 11, although the magnification is the same.

The outer granular layer does not differ materially in appearance in the various parts of the retina, with the sole exception of the inner papillary or third area. There where we find the third system of the bacillary layer, we notice, as shown in Fig. 25, besides the granules and the cone-sheaths, a large number of considerably smaller granules which contain a more homogeneous substance than the granular mass which fills the larger granules.

Why there should be an additional form of granules so much smaller than the rest, and staining so differently, and why they should only be found in this small inner papillary area, I have been unable to discover.

With the above sole exception the outer granular layer

differs in the various parts of the retina in width only, being narrowest in the peripheral area. Of course, as the number of cones increases, we find a larger number of sheaths, while the granule strings diminish proportionately.

Michael Foster, in the latest edition of his *Physiology* (p. 1205), states that the rods relatively numerous at the peripheral parts of the macula gradually grow scanty, and finally disappear, so that cones only are left at the fovea itself. I quite agree with this statement, except that I find at the fovea itself, and even at its very centre, every cone is surrounded by a single circle of rods.

In vertical sections this may not be very apparent when examining the bacillary layer itself, but it can be clearly seen when the outer granular layer is examined. There we find the cone-sheaths, the so-called Müller fibres, close together, but between each pair of these fibres a fine rod-fibril, supported by granules, can be distinctly discerned.

In fact we may say that in all portions of the retina we find specialized medullated and specialized non-medullated nerve-fibres; the former increasing in frequency as we approach the fovea, until we find every medullated fibre surrounded only by a single circle of extremely delicate non-medullated fibres.

In other words, the non-medullated fibres (rod-fibrils) are protected in the bacillary layer by sheaths similar to those which protect the cone-fibrils. Hence, when the bacillary layer only is viewed vertically we find a marked difference between rods and cones in the peripheral area, so that we can distinguish them without hesitation, but as the structure becomes more delicate, this difference gradually diminishes until at length at the fovea itself the appearance of the two kinds of fibres is identical. A glance at Fig. 19, showing the fifth system of the bacillary layer, will make this more evident. But we must bear in mind that the difference between the rod-sheaths and the cone-sheaths in the bacillary layer is that the latter only are filled with a protoplasmic substance, a differentiated transparent medullary sheath, and that the difference therefore can be seen in transverse sections. When we come to the outer granular layer we

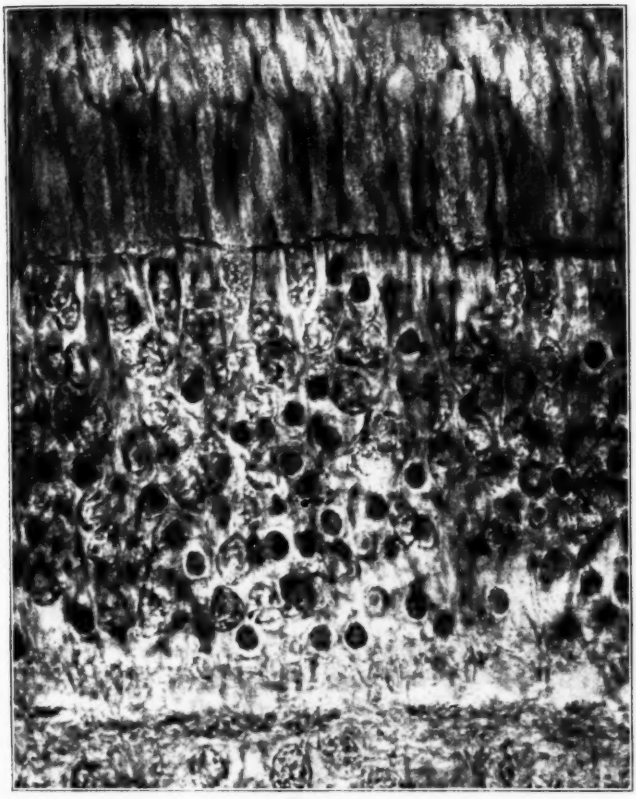

FIG. 25.

Vertical section through the outer molecular and outer granular layers in the third or inner papillary area, showing the two different forms of granules found only in this portion of the retina. The large granules contained in the Müller sheaths in contiguity with the membrana limitans can also be seen. x 1000 diameters.

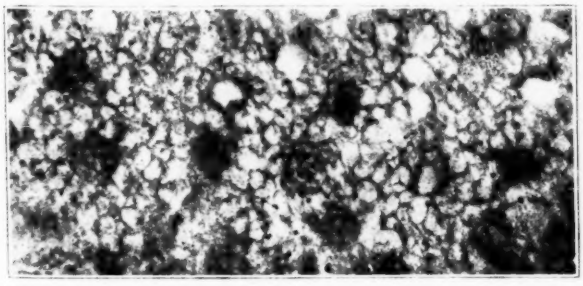

FIG. 26.

Transverse section through the outer molecular layer x 1000 diameters. This picture shows the cone-sheaths as dark patches passing through a network, in each of which we find a rod-fibril supported by radiating fibrillæ.

can distinguish between them in vertical sections because the cone-sheaths continue as so-called Müller fibres, bearing the cone-fibril in their centre surrounded by a medullary sheath, whilst the non-medullated rod-fibrils emerge from their bacillary sheaths, and traverse successive granules until they enter the meshes of the outer molecular layer.

The specimen represented in Fig. 24 was obtained at the edge of the foveal pit. In this transverse section the rods and cones can be clearly distinguished. Comparing this picture with Fig. 11, given in my previous paper, and representing a section from the peripheral area, we find that the cones and rods are considerably more delicate at the fovea, and that the rods are much fewer in number, but that contrary to the generally accepted view there are rods present throughout the macula and at the fovea itself.

E.—THE OUTER MOLECULAR LAYER.

The outer molecular layer consists of a fine network in each of the meshes of which we find a rod-fibril supported by radiating fibrillæ, except there where the constricted cone-sheaths (Müller fibres) pass. This is shown in Fig. 26.

A comparison between this transverse section of the outer molecular layer and the transverse sections shown in this and my previous articles, seems to confirm the description I have given of the mode of insulation of the cone- and rod-fibrils. In fact to my mind the similarity between the outer molecular layer (Fig. 26) and the distal portion of the rods and cones (Fig. 12) as seen in transverse sections is most striking, and confirms to my mind the conclusion that we are in the presence of continuous medullated and non-medullated fibres differentiated for the purposes of this special sense organ.

The outer molecular layer when viewed vertically appears throughout the retina as a narrow streak of close network interrupted at regular intervals by the Müller sheaths (cone-fibre sheaths) which pass through it. Therefore of course the interruptions occur at shorter intervals in those parts of the retina in which cones are more abundant. The appear-

ance of the layer is shown in Figs. 24 and 26 as well as in the accompanying folded microphotograph.

If we consider the blood supply only, we can divide the retina into three distinct and sharply defined parts. An inner part with large blood-vessels, a middle part with capillaries only, and an outer part in which both capillaries and blood-vessels are wanting. It is the molecular layers which divide these three zones. Outside of the outer molecular layer, which we are now discussing, there is no apparent blood supply, but immediately we pass inside this layer we find numerous capillaries, and in the same way we do not find large blood-vessels until we have passed the inner molecular layer. Therefore these molecular layers must play an important part in regulating the areas of the blood and lymph supply. Besides this, however, the close network of the molecular layers entwining the cone-sheaths which pass through them, constitute the chief sustaining plexi of the retina. In specimens which have been prepared with unnecessarily severe reagents I frequently find the tender network of the granular layers as well as the rod-fibrils entirely destroyed and the granules washed out. The skeleton of the retina—if I may so call it—remains behind, consisting merely of the cone-sheath sustained by the so called limiting membranes and the molecular layers.

F.—THE MACULA PLEXUS.

Various authors have pointed out that at the macula region a special differentiation occurs internally to the outer granular layer. Some have referred to this as the inner portion of the outer granular layer itself, others describe it as a separate layer. Dimmer[1] has devoted considerable attention to this layer, and reviews the opinions held by previous investigators. In the text-books, as a rule, little or no reference is found to this layer. Up to the present the opinion has prevailed that this special differentiation is due to a sloping of the cone-fibres away from the fovea.

[1] *Beiträge zur Anatomie u. Phys. der Macula Lutea des Menschen.* Leipsic und Wien, 1894.

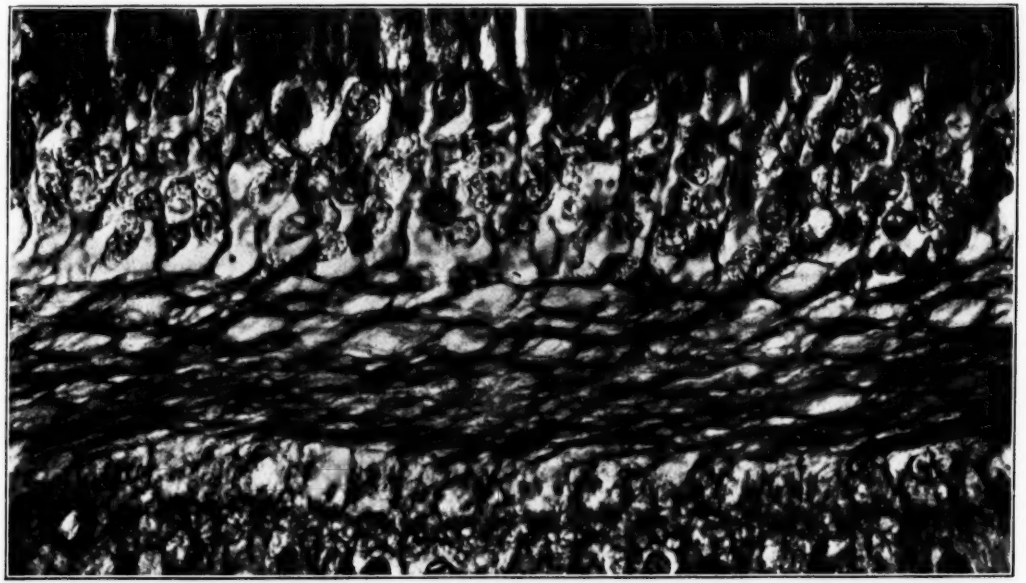

FIG. 27.

Vertical section through the retina near the point where the macula plexus first appears, showing the border layer well defined. x 1000 diameters.

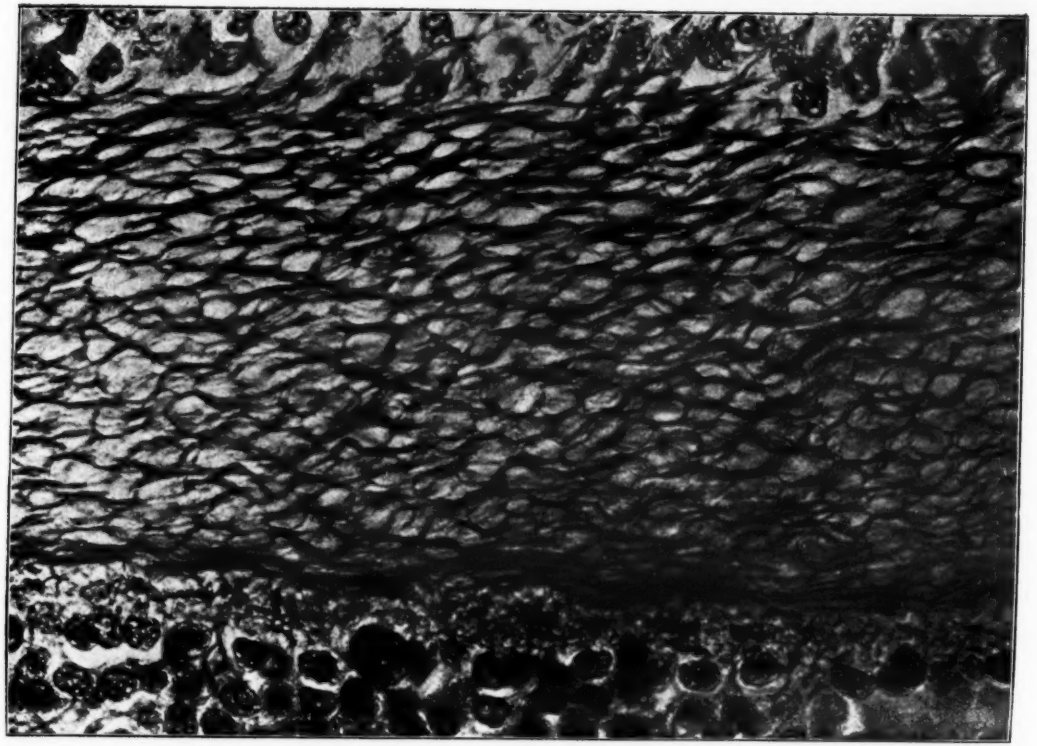

FIG. 28.

Vertical section through the retina showing the macula plexus at its broadest point near the fovea. At this point the border layer ceases. x 1000 diameters.

I find this in the main correct, but evidently what has been described as cone-fibres must be regarded as sheaths carrying the cone-fibril in their centres, or, in other words, the medullated fibres of the retina. These cone-sheaths slant away from the fovea and are sustained by a network of fine connective-tissue fibres. Moreover the meshes of this fine network sustain the delicate rod-fibrillæ. Near the fovea, where each rod alternates with a cone, the slanting sheaths are very numerous and lie close together; and as moreover they are wavy in their course, the whole structure presents the appearance of a coarse-meshed network when viewed with low powers, as will be seen on reference to the folded microphotograph. With high powers the sustaining network and the rod-fibrils can be seen as shown in Fig. 28. Farther away from the fovea the cone-sheaths are somewhat less numerous, and their course can be more clearly followed (see Fig. 27). The network which sustains the slanting cone-sheaths, as well as the delicate rod-fibrils which run through the meshes of this network, become easily destroyed during the preparation of the specimens, leaving the sloping cone-sheaths behind. This accounts for the description hitherto given, and the names selected by various authors. Max Schultze speaks of a fibrous modification of the inner half of the outer granular layer. Henle calls it the outer fibre layer. It has also been called the neuro-epithelium layer and the cone-fibre layer. I propose to name it *the macula plexus.*

The first distinct trace of the macula plexus is to be met with at about 1 *mm* from the outer edge of the disc; from this point it widens gradually until it comes within 0.2 *mm* of the fovea, where it narrows again, ceasing abruptly at the fovea itself. On the other side of the fovea it appears again, attaining its greatest width at about 0.2 *mm* from it; and then it continues narrowing gradually, until it finally ceases to be visible at the termination of the fifth system. The annexed folded microphotograph shows the entire extent of this plexus. Fig. 28 is a microphotograph taken at the widest portion, Fig. 27 is a microphotograph taken at about half a millimetre from the point where it first appears.

FIG. 28.
Vertical section through the retina showing the macula plexus at its broadest point near the fovea. At this point the border layer consists. × 1050 diameters.

G.—THE MACULA PLEXUS BORDER LAYER.

Between the macula plexus and the outer molecular layer I find a further differentiation so marked that I think it must be described as a separate layer, and I propose giving it the above name.

This layer runs all along the inner border of the macula plexus, as can be clearly seen in the accompanying folded microphotograph; it is of equal width throughout its course, measuring about 10 μ. Near the fovea it gradually narrows to a point ceasing just before the plexus itself. It is shown very clearly in Fig. 27, but is nearly absent in the part shown in Fig. 28.

In this layer the cone-sheaths run at right angles to the plain of the retina, being sustained by a network, through the meshes of which the rod-fibrils run.

From this border layer cone-sheaths and rod-fibrils enter the outer molecular layer, which forms all along the well marked inner edge of the border layer.

Recapitulation.

The retina is a continuous uninterrupted structure limited internally by the membrana limitans interna, and externally by the membrana terminans retinæ which is the external limit of the hexagonal layer contiguous with the choroidal membrana vitrea. The so-called membrana limitans externa consists of stout connective-tissue fibres and serves as a support to the bacillary layer. Throughout the retina we can distinguish two forms of nerve fibres; the one belonging to the cones, the other to the rods in the bacillary layer. The former kind consists of a sheath containing the cone-fibril supported by radiating fibrillæ surrounded by a protoplasmic mass which is a differentiated and specialized form of the white substance of Schwann; so that we may regard the cone-fibres as specialized medullated fibres, whilst the rod-sheaths contain a fibril which is not surrounded by this protoplasmic substance; and as the rod-fibrils moreover emanate from the rod-sheaths in the bacillary layer as simple axis-

cylinders, we must regard them as non-medullated fibres. The specialized medullated and non-medullated fibres can both be traced as such in the optic nerve, and from the optic nerve through all the layers of the retina to the spherules in the hexagonal layer. The sheaths of the medullated nerve fibres are sustained by the molecular layers, the stout fibres of the so-called membrana limitans externa, and the crystal pigment plexus. These together form a substantial structure, the interstices of which are filled out with delicate networks in the meshes of which granules are suspended, through which the non-medullated axis-cylinders or rod-fibrils run. In the molecular layers the rod-fibrils run through the meshes of the plexus. Both the cone-fibrils (the axis-cylinders of the medullated nerve-fibrils) and the rod-fibrils (or non-medullated fibres) are supported throughout their course by fine radiating fibrillæ. The molecular layers, moreover, evidently play an important part in regulating the blood and lymph supply, as they divide the zone of large blood-vessels from the zone of capillaries, and that again from the non-vascular zone. The rod-fibrils run through the centre of the granules, which are spherical bodies filled with a granular substance insulating and sustaining the fibrils, which are, moreover, there held in position by radiating fibrillæ. The outer granular layer only differs in width in the various portions of the retina, with the exception of the third or inner papillary area in which an additional smaller form of granules is to be found.

The outer molecular layer is a narrow streak of close network of about equal width throughout the retina. Through the meshes of this network the rod-fibrils run supported by radiating fibrillæ, and it is likewise traversed by the cone-sheaths or medullated fibres.

On the inner side of the disc and at about 1 *mm* from it, a special plexus which I have termed the *macula plexus* originates, and continues widening until it comes within 0.2 *mm* of the fovea, where it narrows again, ceasing abruptly at the fovea itself. On the other side of the fovea it appears again, attaining its greatest width at the same distance from it, and then it narrows gradually until the end of the fifth

area is reached. This macula plexus consists of cone-sheaths sloping away from the fovea, the spaces between them being filled with a fine plexus in the meshes of which the rod-fibrils are sustained by radiating fibrillæ.

Between the macula plexus and the outer molecular layer we find a special layer which I have termed the *macula plexus border layer*. In this layer the cone-sheaths run at right angles to the plane of the retina sustained by a plexus through the meshes of which the rod-fibrils run, and they, as well as the cone-sheaths, thence enter the outer molecular layer.

Remarks Concerning the Annexed Folded Microphotograph.

Having obtained specimens perfect throughout, from the disc to the end of the fifth system, in a line drawn through the disc and the centre of the fovea, I have selected one of these specimens, and have been able, thanks to a special photographic microscope fitted with a mechanical and rotating stage, to take a series of microphotographs which, exactly adjusted to each other, have rendered it possible for me to show the macula plexus throughout its entire course. The bacillary layer is the only one which, especially in its distal portion, has suffered during the preparation of the specimen. The eye was obtained from a person sixty-five years of age. I mention this because of the shape of the fovea, which, as I hope to show in a future article, varies with age, and to some extent with individuals.

The microphotograph represents the retina magnified exactly 250 diameters, so that all measurements taken on the photograph itself can be correctly calculated as compared with the specimen, or in other words with the eye itself.

By magnifying exactly 250 diameters I have produced a photograph in which 1 *mm* corresponds to 4 μ in the specimen, or to put it in inches: 1 inch on the photograph = 100 μ or $\frac{1}{10}$th *mm* on the specimen.

By means of the rotating mechanical stage I brought each separate photograph of the series parallel to the side of the

plate, thus avoiding the curvature which would have rendered the publication of the picture more difficult. As each plate corresponded to about half a millimetre in the specimen the amount cut off by this adjustment is infinitesimal, and can therefore be safely ignored.

Measurements of the Macula.

Although I may be entrenching to some extent on matter which I had reserved for a future article, I think it will be of interest if I now give some indication of the opinions I have so far formed as to the size of the macula and the fovea. The annexed folded microphotograph will assist me in doing so.

There seems to be considerable diversity of opinion as to what we have to understand by the macula and what by the fovea.

If the reader will refer to my first paper on this subject in vol. xxi. of these ARCHIVES, he will find a number of colored drawings of the macula reflex ring and the foveal reflex; and he will find that the difference of color noticeable with the ophthalmoscope over the macula region is limited by the inner edge of the ring. If we therefore measure the diameter of the ring as defined by the inner edge, and reduce it to its actual size and then increase it again by the magnification of the microphotograph, and transfer the measure thus obtained to the microphotograph, we can determine the boundary of the macula.

Now the pictures in vol. xxi. are drawn of a magnification of 10 diameters, and the average diameter is 14 *mm*, so that the area of deeper color—the macula—measures 1.4, which multiplied by 250 = 35 *mm* or 17½ *mm* from the centre of the fovea on either side. This I have indicated by dotted lines, and it will be found to correspond to the spot where the dip first becomes accentuated.

If I measure the ill-defined outer edge of the macula reflex ring in the pictures above referred to, I obtain an average which corresponds to 1.8 *mm* in the eye, which multiplied by 250 = 45 *cm*, which measured off on the microphotograph

corresponds to the place on each side where the dip is first slightly noticeable. The floor of the fovea in the microphotograph measures 7.5 *cm*, which corresponds to 0.3 *mm* in the eye, which is the average I obtain by measuring the foveal reflex in the colored pictures and dividing by 10.

In explanation of the magnification of 10 diameters in the pictures in vol. xxi., I may mention that Helmholtz has calculated the magnification by the direct method as 14.3 diameters; Landolt gives it as 20 diameters; Dimmer's calculation gives 16.6 diameters. As, however, the projected image varies with different observers and with the distance to which it is projected, I have observed the size of the disc and obtained it exactly 10 times the natural size, and then drawn the macula ring to scale. The disc measures on an average 1.5 *mm* when measured with callipers in the enucleated eye, and I obtain the same measurement with the micronometer eye-piece when measuring the disc in my microscopic sections. It is when I saw the disc 15 *mm* in diameter that I have drawn the macula ring as in the pictures referred to.

If we take the distance from the retina to the nodal point in the lens as 15 *mm*, we find that 1.4 *mm* corresponds to 5.4 degrees. The angle corresponding to the area of distinct vision is generally admitted to be slightly over 5 degrees, and I have found this correct when I have tested it.

The dotted lines on the microphotograph, corresponding to 1.4 *mm* in the specimen, indicate the limits of the region which appears darker with the ophthalmoscope, and this also agrees with the area of distinct vision.

We must therefore evidently regard the macula, the seat of acute vision, as corresponding to the dip, and the fovea as the pit in the middle of this macula area.

It is remarkable that nothing but the dip in the retina should indicate the macula, and that nothing in the structure of the retina itself seems to correspond to this dip. The macula plexus reaches far beyond it on both sides, and does not reach its maximum width there where the dip first com-

mences, nor does it correspond to the limits of the fourth or fifth system of the bacillary layer.

I am continuing my work on the subject and may in a future paper be able to indicate some histological peculiarity of the macula other than the dip, but at present I am inclined to think that the acute vision at that spot, and the difference of color noticeable there, may be due to physiological rather than histological conditions.

(*To be continued.*)

THE SPHENOIDAL CAVITY AND ITS RELATION TO THE EYE.

With 10 Illustrations, and Tabulated Measurements of Fifty Specimens from the Author's Collection.[1]

By Dr. C. R. HOLMES, Cincinnati.

IN reading the discussions which occurred at the meeting of the British Laryngological, Rhinological, and Otological Association, held during the summer of 1895, a report of which was published in the *Journal of Laryngology, Rhinology, and Otology* in September of the same year, I was forcibly struck with the fact that the measurements of the sphenoidal cavity and the relations of the ostium sphenoidale are not very clearly understood even by some of the authorities.

Having during the last five years devoted much time and attention to the accessory cavities, in health and disease, and made numerous dissections, it struck me as a remarkable fact that Dr. Collier, for years a teacher of anatomy in the London Hospital, should affirm that "in many cases the sphenoidal cells have no communication whatever with the upper meatus of the nose, *only* with the posterior ethmoidal sinus."

Now we all admit that communications do exist between these cavities as a result of disease, but, as I understand it, Dr. Collier maintained such a state of affairs was frequently found in health.

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[1] The MS. of this paper was received by the editor on June 11, 1896. The table was missing. The author, absent in Europe, when informed, replied to publish the paper; he would furnish the table with additional remarks later on.—*Editor*.

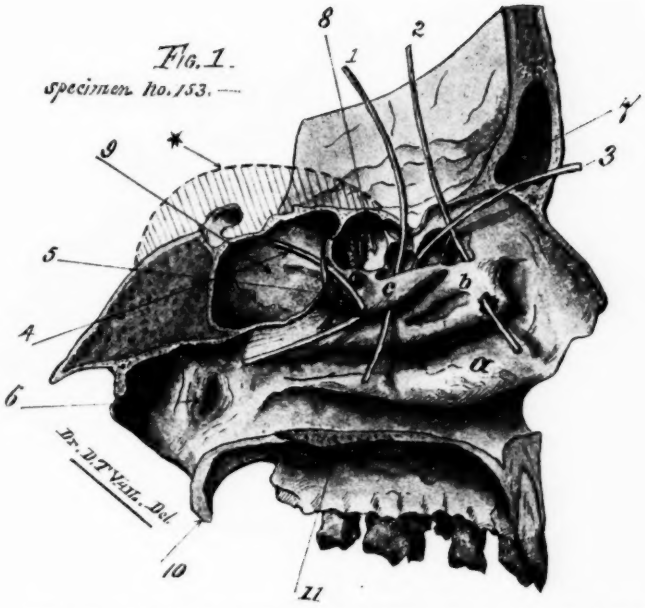


Fig. 1.—1 and 3. Probe passing through outlets of anterior ethmoid cells. 2. Probe passing through opening made with chisel into cell in anterior part of middle turbinated (this cell not constant). 4. Probe passing through ostium sphenoidale. 5. Arrow indicating outlet of posterior ethmoid cell. 6. Mouth of Eustachian tube. 7. Frontal sinus. 8. Posterior ethmoid cell. 9. Sphenoidal cavity. 10. Uvula. 11. Hard palate. *a*, *b*, and *c*. Inferior, middle, and superior turbinated. * Diagrammatic representation of blood-clot found in Case B (Mr. Isler).

Professor Krause also stated that the opening to the sphenoidal sinus is located behind the posterior end of the middle turbinated. This is probably either quoted incorrectly, or the Professor did not express himself clearly, for we cannot doubt his familiarity with the minute details of these parts, but nevertheless it is important that we should be explicit as to the location of these openings, otherwise we shall cause failures on the part of those who read these reports and try to enter the openings according to our descriptions.

By referring to column $7\frac{1}{2}$ it will be seen that there are measurements of thirty specimens, giving the distance from the centre of the ostium sphenoidale to the *upper margin of the posterior end of the middle turbinated, measured on a perpendicular line.*

It will be seen from this that the opening is *not* behind the posterior end of the middle turbinated, but above it, the shortest distance being 7 *mm*, the longest 16, and the average 12. In Fig. 1 it is 10 *mm*.

In order to further the minute and careful study of these cavities, I selected fifty specimens from my collection, each one of which would show some of the measurements desired, the number depending upon the manner in which the section was made.

This will explain why, although fifty sphenoidal cavities were examined, the footings in the columns do not make up this amount, because it was not always possible to obtain certain measurements. I numbered the columns from 1 to 36, to facilitate reference. Twenty of the cavities are rights and lefts from ten heads; the other cavities were either rights or lefts from as many different heads.

As will be seen, they are rather evenly divided, there being 26 lefts and 24 rights.

Columns 1 to 5 give the location, shape, and size of the ostium sphenoidale. Thirteen times (or in 29%) it was located near the septum. Thirty-two times (or in 71%) it was located outwards in the recessus spheno-ethmoidalis. In five cases no measurements. Twenty-six times (or in 52%) the opening was found oval, at times almost round. Eighteen

times (or in 36%) it was slit-like, the long diameter varying from 1 to 7 *mm*, the average being 3.[1]

I was particularly careful, after reading Mr. Collier's statement, to examine for *an opening from the sphenoidal cavity to the posterior ethmoidal sinus, and not in a single one of the fifty cases did it exist.*

From these and other examinations I am led to believe that direct communication between these cells does not exist, excepting as a rare anomaly, or in disease.

In column 7 we find the distances between the opening of the sphenoidal cavity and the posterior ethmoidal cell.

The direction and location in the latter varies greatly. At times it is almost directly backward and high up; if the recessus spheno-ethmoidalis is very narrow and slit-like, then the two openings may come in close proximity, as in specimen No. 111, where they are only 1 *mm* apart, or the opening may point downward, or downward and forward, or even forward, and the distance may be as much as 15 *mm*, as in specimens Nos. 101 and 102. The average distance is 5.5 *mm*.

Columns 8, 9, and 10 give the directions of the outlet of the posterior ethmoid cell; 17 opened downward and backward, 4 downward, 9 downward and forward, and 2 forward.

Columns 11 and 12 inform us that 18 times (or in 39%) it would be possible to enter the sphenoidal opening by means of a probe, and 28 times (or in 61%) it would have been impossible, for the reason given in columns 13 and 14, to wit: 27 times (or in 61%) the middle turbinated, 17 times (or in 39%) the superior turbinated and ethmoidal cells, and 16 times both would have prevented it.

Columns 15 to 18 inform us as to the thickness of the anterior wall, floor, and roof of the sphenoidal cavity. The measurements refer of course only to the bone carefully measured from the sections. I will admit that when it comes down to 0.25 or 0.5 *mm* one must exercise consider-

[1] In perfectly fresh specimens the opening is perhaps more frequently slit-like than oval, and smaller; the preserving fluid causing some shrinkage of the thin membrane covering the larger bony opening in the anterior wall of sphenoid.

able care, for errors are bound to creep in, but are so slight as to be of no practical value.

In order to convey more clearly what 1 *mm* really represents, it is well to bear in mind that ten leaves of Gray's *Anatomy* firmly pressed together is about 1 *mm*.

It will be seen that the thickness of the anterior wall near the roof, varies from 0.15 *mm* to 2 *mm*. We are frequently apt to think that bone 0.25 *mm* thick or even 0.5 *mm*, can easily be penetrated by forcible probing in healthy tissue. Such is not the case, as can readily be demonstrated.

Near the floor the anterior wall was found to vary in thickness from 0.2 to 2.5 *mm*—average being 0.68. The measurements of the floor of the cavity vary much more than the others, from 0.25 in specimen No. 107 to 5 *mm* in specimen 101—1.81 *mm* being the average.

The thickness of the roof of the sphenoidal cavity fluctuates from dehiscence, as in specimen No. 142 L, to 3.0 *mm* —average being 0.8.

Columns 19 and 20 give the measurements of the cavity. Here we find marked fluctuation, the antero-posterior diameter varying from 10 *mm* in specimen No. 108 to 51 *mm* in specimen No. 136—the average being 22.8; while the height varies from 9 to 28 *mm*—the average being 19.

Only in fourteen specimens did I measure the cubic contents of the cavity, and found here still more marked fluctuations. Specimen No. 113 R contained only 0.78 *ccm*, while specimen No. 136 L contained 17.6, and the average was 6.67 *ccm*.

From columns 22 to 27 we find the thickness of bone between the sphenoidal cavity and the foramina rotundum and opticum. It will be seen that comparatively few measurements were made because specimens are generally not cut for that purpose.

We have, however, the measurements relating to the foramen rotundum from 27 specimens. In one of these, No. 145, dehiscence is found; and ten times it was about the thickness of paper, under which head I have classified measurements from 0.1 up to 0.25 *mm*.

Seven specimens were classified as thin, or varying in thickness from 0.25 *mm* to 0.5 *mm*, and ten specimens thick, varying from 0.5 to 2 *mm* or more.

In regard to the optic foramen, we find two cases where dehiscence exists, specimen No. 142 L, and specimen No. 146 R, and fourteen where the bone was classified as "like paper." *It is from extension of the disease existing in the sphenoidal cavity, through this thin wall, that many cases of obscure retrobulbar neuritis develop, and often end in blindness; and it is through the lateral wall that the inflammation can extend to the bundle of nerves and vessels as they pass through the sphenoidal fissure* (see Fig. 3), *causing neuralgia of the first division of the fifth, and this may, in a measure, explain why we have this branch far more frequently affected than the other two.*

As to the shape of the septum between the two sphenoidal cavities, columns 28 and 29 inform us that in 50 % of the cases the septum was straight, and that ten times it deviated to the right, and eight times to the left. It is a fortunate thing, in order to prevent the extension of inflammation from right to left, and vice versa, that the septum is generally quite thick as compared with the other walls.

In column 30 we have the distance given from the introitus nasi to the ostium sphenoidale. I beg to state here that while the specimens with three exceptions are moist, the shrinkage of the upper lip is quite marked in some that were preserved in alcohol, while those preserved in Wickersheimer's solution are practically normal. This of course will create a slight difference in the measurements, but on the whole it can only amount to from 2 to 3 *mm*.

The shortest measurement is 50 *mm* in specimen No. 130 and the longest 75 in specimen No. 127—the average being 61. 8 *mm*.

In column 31 will be found the distance a straight probe would enter the sphenoidal cavity before encountering the roof, said probe touching where the upper lip and nose join, and passing through the ostium sphenoidale, which places it at an angle of about 35 to 40 degrees from a perpendicular line.

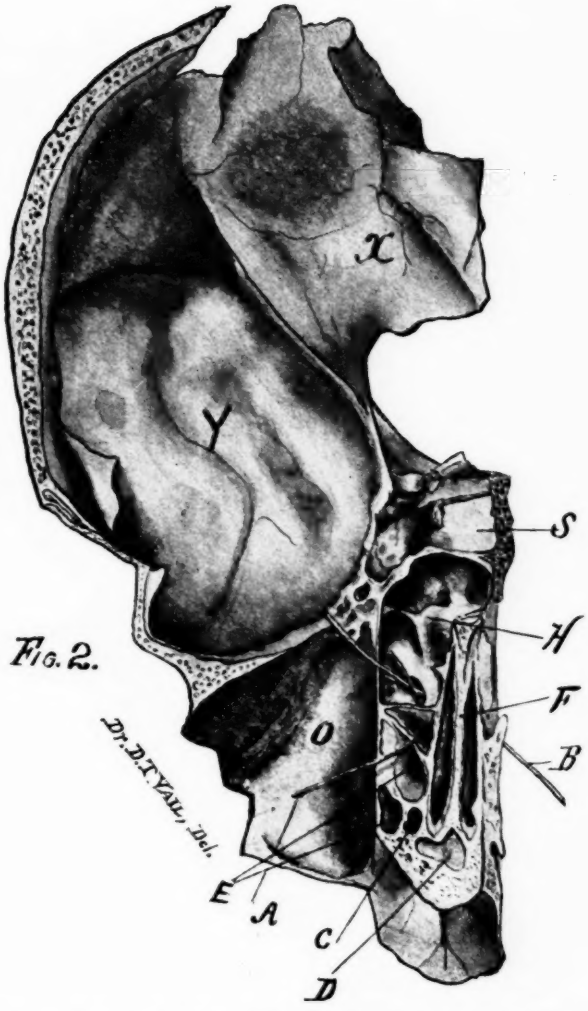


Fig. 2.—Horizontal section through ethmoidal cells, cut 23 *mm* above Frankforter line. A. Probe passing through opening from middle to posterior ethmoidal cell. B. Probe passing ostium of posterior ethmoidal cell. C. Outlet of frontal sinus. D. Floor of frontal sinus. E. Anterior ethmoidal cells. F. Septum. O. Orbit. S. Sphenoid. X. Dura. H. Enormously enlarged posterior ethmoidal cell, with irregular walls. Y. Middle fossa.

The object of this column is to show how greatly these distances vary, depending not so much upon the size of the cavity as upon its shape. Care should be exercised not to use a stiff probe too forcibly lest damage might be done to important parts found in this region, if the walls are softened by disease. This distance varies from 5 to 20 *mm*, and the average is 12.

I have given the measurements in column 32 because it will assist materially in locating the cavity; *on an average the floor of the sphenoidal cavity is* 25 *mm above the upper surface of the hard palate*, but this height also fluctuates, as will be seen in specimen No. 117, where it is only 15 *mm* while in specimen No. 123 it is 36. In Fig. 1 it is 23.

How much age and sex influence these measurements can only be determined by extensive tables of this kind. Three of the cavities in this collection are from the negro, all the rest Teutonic; the majority of these were old, the youngest being twenty-five and the oldest ninety—average fifty-two.

Disease of the accessory cavities is principally found in adults. Specimens from ten to twenty years of age would be interesting and useful, but this class are unfortunately quite difficult to obtain.

Among the 50 specimens I found a few differing so materially from the average that it may be of interest to give them special mention.

[1] Specimen No. 102. The outlet of the posterior ethmoidal cell is in front, and high above the floor under the superior turbinated.

[2] Specimen No. 110. Absence of the sphenoidal cavity of the right. Its place is filled with open cancellous tissue, but the line of demarcation between the latter and the walls of the cavity is sharply defined. Left sphenoid cavity very small. The other accessory cavities are normal.

[3] Specimen No. 116. Has almost a complete bony septum in left cavity.

[4] Specimen No. 128. Nearly all of anterior wall is membranous.

[5] Specimen No. 131, right. Dehiscence of bony partition between sphenoidal cavity and posterior ethmoidal cell. Bone between carotid and sphenoidal cavity is only the thickness of paper.

[6] Specimen No. 131, left. Five *mm* along the oblique diameter from the ostium sphenoidale upwards and backwards (see column 31) the probe encounters bone, which is the anterior wall of right sphenoid, the latter passing entirely behind the left.

[7] Specimen No. 132. Dehiscence in sella turcica.

[8] No. 136. The sphenoidal cavity occupies all of the basilar process, as far down as the articulation of the first vertebra, the cortex varying in thickness from 0.5 to 1.0 *mm.* Forward and downwards there are several extensive infundibula.

[9] Specimen No. 138. In this specimen the space, which should be occupied by the sphenoid cavity, is filled with cancellous tissue. The posterior ethmoidal cell is enormously developed, having encroached some upon the space usually occupied by the sphenoid.

This specimen has been most carefully examined. (See Fig. 2, Plate ii.) There are two outlets from this cavity, shown by probes "A" and "B." "A" passes through the opening between the middle and posterior ethmoidal cell, and "B" is the natural outlet of the posterior ethmoidal cell, opening downwards and forwards below the superior turbinated.

The other side is practically the same, excepting that the area occupied by the cancellous tissue of what should be the sphenoid extends farther forward, making the posterior ethmoidal cell smaller.

[10] Specimen No. 143. Dehiscence of bony partition wall between the posterior ethmoidal cell and the sphenoidal cavity, but no communication.

Having now studied the cavity and its relations, we are in a position to more thoroughly appreciate the section shown at Fig. 3, *which was prepared from a specimen frozen immediatly after death.*

The cut is directly in front of the optic chiasm, cutting through the optic foramen. As will be seen from the drawing, where the thickness of the bones has been reproduced with the greatest accuracy, there is considerable difference between the *outer wall* of the optic foramen as regards the right and left sides, while the roof of the cavity in this specimen is quite thick, *but the bone between the cavity and the optic canal and sphenoidal fissure is like paper.*

Fletcher Ingalls and Zeim both advise the opening of the sphenoidal cavity from below through the mouth by means of a dental drill, working at right angles. I have tried drilling through the floor upon the cadaver and believe it to be dangerous and impractical, nor is there any need for its adoption, as the other method is easier and safer.

Report of Cases.

CASE A: Purulent Inflammation of Left Sphenoidal Sinus—Intense Headaches—Total Loss of Sight of Left Eye—Opening of Cavity—Recovery of Vision.

CASE B: Unrecognized Empyema and Necrosis of Sphenoid—Visual Disturbance—Cerebral Hemorrhage—Death—Post-Mortem Notes.

CASE C: Empyema of Sphenoidal, Ethmoidal, and Frontal Sinuses—Cerebral Abscess—Death—Post-Mortem Notes.

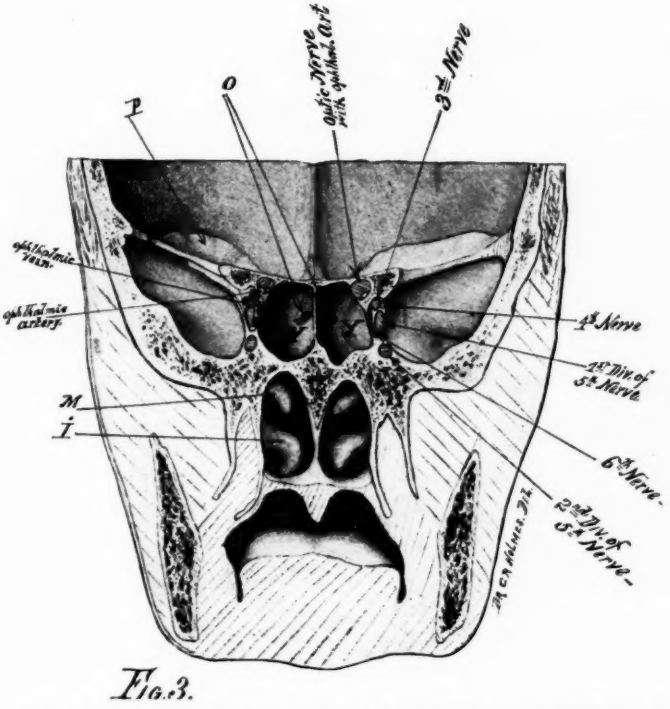


Fig. 3.

FIG. 3.—Frozen section of anterior half of head, cut immediately in front of chiasm. P. Orbital roof of frontal sinus. O. Ostium sphenoidale. V, V. Right and left sphenoidal cavities. I, M. Inferior and middle turbinateds.

CASE A.—*Unrecognized Empyema of Left Sphenoidal Sinus; Intense Headaches; Total Loss of Sight in Left Eye; Opening of Cavity; Recovery of Vision.*

Mr. W. H. Welland, age thirty-seven, carriage manufacturer, has during his life at intervals suffered from headaches of the ordinary character, but during the past year they became much more frequent, more severe, and limited principally to the left side; the pain would be in the temple, and deeply seated behind the eye, radiating to the back of the neck immediately below the occiput.

To relieve the pain, patient would rest his head upon left hand, and pinch the skin over the temple and brow, and at times place the hand under the occiput and to the left, where pressure would also give relief. Headache would come gradually, last two or three days, and slowly subside. Never had nausea, dizziness, or vomiting at such times. When suffering from these attacks, there was a heavy unpleasant feeling about the eye, but vision was never interfered with until two weeks before I saw him, when the eye was very painful, and there was a blur over it. He consulted Dr. R. L. Thomas, who was unable to detect anything beyond what appeared to be a cold settled there, and advised consultation if the eye continued unfavorable.

The following day, patient found that by going into a dark room from the light, remaining there a few minutes, and then going into the light again, the eye was totally blind for about 5 minutes, and when vision slowly returned it was cloudy and obscured. This impressed him so, that he made the experiment several times, with the same result. The following day, however, vision became very defective and the pain increased.

He was first seen by me December 19, 1895, when I found the following condition:

Character of pain dull and steady. Movements of eyeball in any direction caused pain, which seemed to be located in the muscles. The eyeball exquisitely tender to the touch. There was also slight exophthalmos. Pupil still active, and no evidence of iritis. A slight conjunctivitis with engorgement of vessels existed. Supraorbital notch exquisitely tender on pressure. Vision of left eye with correcting lenses was $\frac{20}{100}$. Dioptric media clear, margin of disk slightly hazy; arteries about normal, but there was venous engorgement. Field of vision normal, but he complained of a haze over all objects. Tension normal.

Tongue coated and stomach disturbed, probably caused from morphia which he had been given to allay the intense suffering.

Careful examination of the nose revealed almost total stenosis of the left side, due to deviation of septum secondary to an old fracture. Hypertrophy of middle turbinated. There was no marked abnormality of secretions as revealed by anterior and posterior rhinoscopic examinations. *About this he was very carefully questioned, because the chain of symptoms pointed to the extension of inflammation from the accessory cavities.* There was no history of acquired or congenital syphilis, nor of rheumatism. Of late the pains had been somewhat more intense every morning and evening, this regularity being sufficient to warrant anti-malarial treatment. Patient was ordered to take 30 grains of quinia in divided doses during the two hours preceding the attacks.

On the 21st, reported the pain less severe, but vision only $\frac{2}{200}$. Eyeball less tender.

Dec. 22d.—Remained free from pain in the evening; took no quinia to-day. Suffered intense pain the morning of the 23d. Quinia was continued. Vision improved to $\frac{2}{80}$. Movements of globe better, but still painful. Ordered 30 grains of quinia this evening, and Turkish bath.

Dec. 24th.—No pain last night after taking quinia; rested well, physical condition good, vision $\frac{2}{40}$.

Analysis of Urine.—Specific gravity 1022, acid reaction, color dark amber, slight mucous sediment, albumen none, sugar none, quantity normal.

Dec. 25th.—Complains of dull pain this morning, rather less severe in the afternoon, but became very intense during the night. There is no change in fundus. Pressure on globe causes pain in back part of the orbit, but the œdema and exophthalmus have about disappeared.

Tension normal, no iritis, but vision has been reduced to $\frac{2}{200}$ again. It was evident that the quinia which at first appeared to be of much benefit had lost its value, and on

Dec. 27th, patient was admitted to my private hospital. In a consultation held with his family physician, it was decided to give him the benefit of a thorough course of anti-specific treatment although the history was negative. This was begun, but his sufferings became more intense, and vision on the first of January was totally abolished. Pupil $\frac{2}{3}$ dilated and fixed, and there was not even perception of an electric light.

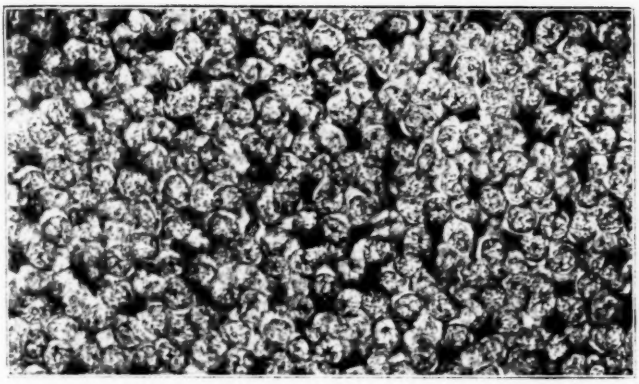


FIG. 21.

Transverse section through the outer granular layer x 1000 diameters. The cone-sheaths are seen as small irregular dark patches, the granules show the ultimate nerve-fibrils (rod-fibrils) passing through their centres supported by radiating fibrillæ.

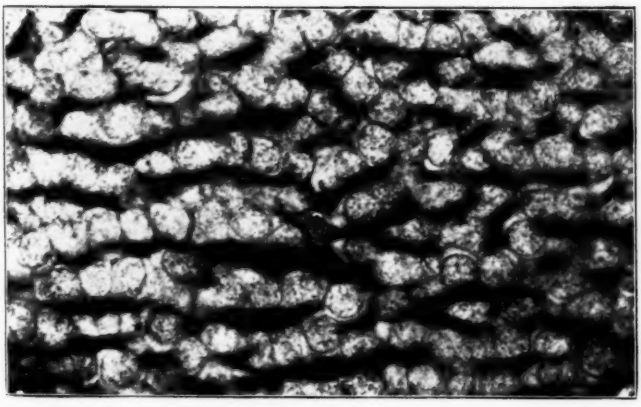
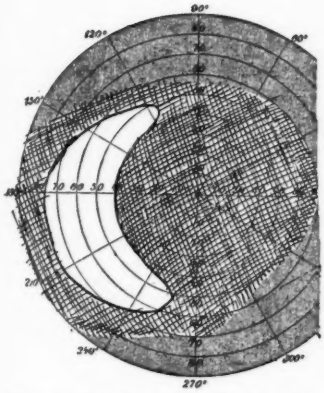


FIG. 22.

Oblique section through the outer granular layer x 1000 diameters, showing the cone-sheaths passing between the granules which carry the rod-fibrils.



Jan. 4, 1896, the day of the operation, the patient had no perception of light.
FIG. 4.—Crescentic field of vision in temporal region, eleven days after operation.

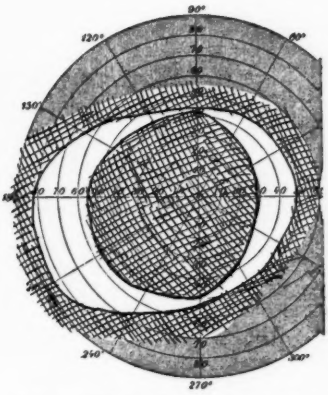


FIG. 5.—Twelve days after operation.

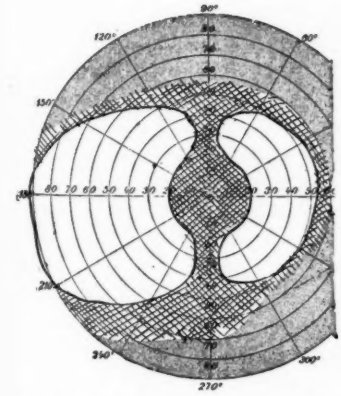


FIG. 6.—Eighteen days after operation.

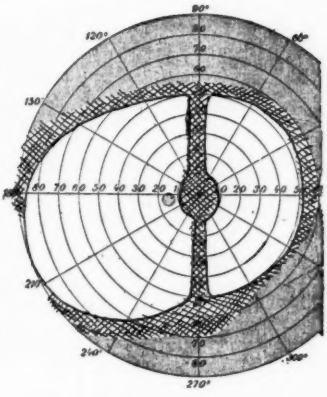


FIG. 7.—Twenty-four days after operation.

Jan. 3d.—Was taken to the consulting room for a thorough examination of nares and accessory cavities. His general appearance was bad. Felt weak. During the examination patient suddenly became very nervous, face pale and pinched, pulse 130. Twitching of right hand and arm. He was put on a sofa, resting about an hour before he was able to be taken to his room.

Jan. 4th.—Drs. Zenner and Ransohoff were both called in consultation, but a careful examination failed to bring forth anything new. The optic nerve was at this time becoming very white, marked reduction of the calibre of arteries, with complete disappearance of the finer branches on the disk. *No perception of light.* I determined to operate at once upon the cavity, notwithstanding the absence of positive proof, as the consultation failed to suggest anything else.

This was accordingly resorted to. Left side cocainized with 5 % solution on cotton pledgets packed into the left nares, which were left in position seven minutes. It was necessary first to remove the middle turbinated, before the sphenoid cavity could be reached ; even then there was barely room to pass a 4 *mm* drill, on account of deviation of anterior part of septum to the left.

Search for the ostium sphenoidale unsuccessful. On account of the hemorrhage from the anterior wound and the exceeding narrowness of the nares, *it was impossible to obtain a view of the deeper parts.* The distance from the middle of the anterior wall of the sphenoid to the entrance of the nares was carefully measured and marked upon my drill, which, being introduced at an angle of 30° to the perpendicular, readily opened the cavity. It was impossible to obtain a view so as to determine by ocular inspection whether pus escaped. Cotton upon a probe carried into the cavity came away so covered with blood that the presence of pus could not positively be stated. After the immediate irritation from the operation had disappeared, patient became entirely free from pain in the head ; also from the painful retraction of the neck muscles, which had been quite marked during the past two days, *In fact, all pain of the eye and head had entirely disappeared twelve hours after the operation.*

Jan. 6th.—The swelling of the nose following the operation has now disappeared. Again passed the probe wrapped with cotton into the sphenoid cavity, and when the head was placed forward, *thick creamy pus could be seen escaping from the opening.* Since the operation patient has been placed upon tonics, and daily

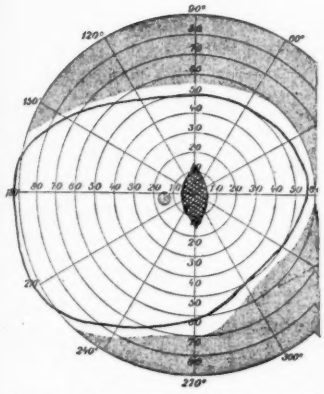


FIG. 8.—Thirty-five days after operation.

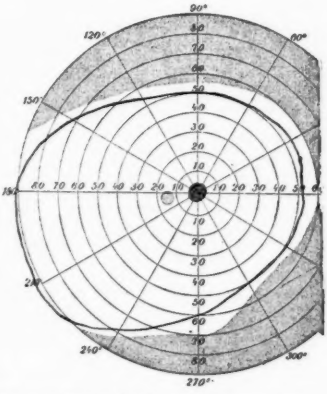


FIG. 9.—Forty-six days after operation.

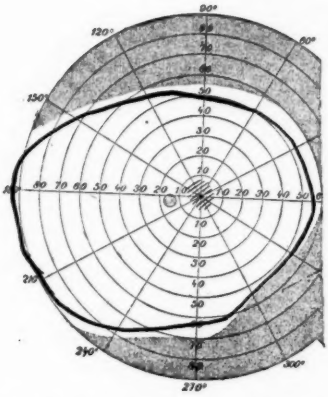


FIG. 10.—March 17, 1896. Seventy-two days after operation. No scotoma for colors; no absolute scotoma. Can read Sn. No. 5, and tell time by watch. Eccentric fixation.

hypodermics of strychnia and mild currents of galvanism to stimulate the affected nerve fibres.

Jan. 13th.—Condition is steadily improving. Still entirely free from pain. For a few days he has noticed a gradually increasing ability to distinguish light. To-day could see movement of the hand held very close to the eye.

Jan. 15th.—Can count fingers, and with a piece of white paper one inch square, the crescentic field seen in Figure 4 was obtained.

Jan. 18th.—From now on there was steady improvement, as shown in the fields of vision, Figures 4 to 10. Veins are normal in size. Calibre of arteries increased, but still below normal.

Jan. 24th.—Ophthalmoscopic examination to-day shows that two capillaries have reappeared on the inner side of disk, but the color, if anything, is whiter than at the time of the operation. It is evident that, although vision has returned, some of the nerve fibres have degenerated, due to prolonged strangulation. There was slow but steady improvement during February.

March 8th.—Patient has suffered from severe headaches during the past two days; there is marked hyperæmia and swelling of the mucous membranes of the nose, which had closed the entrance to the sphenoidal cavity. *On forcing it with a probe, a small stream of thick yellow pus gushed forth, explaining the headaches and deterioration of vision, which promptly disappeared when drainage was re-established.*

Mar. 17th.—Perception of colors has returned in outer half of field up to 10 degrees of point of fixation, and for white there is only a relative scotoma of 5 degrees.

Can now tell the time of watch by slight eccentric fixation, and read Sn. No. 5. The delicate papillo-macular bundle is the only part that is still affected.

April 7th.—Contracted another severe cold, followed by headache yesterday and to-day, and there was a repetition *of the conditions found March 8th.* The opening to the cavity having again been closed by swelling of the mucous membrane, the naris was therefore cocainized, and the opening into cavity enlarged with a drill. Anterior wall was quite thick, and the bone resistant. There was free evacuation of pus, with relief of symptoms.

May 25th.—For two weeks there has been no discharge from the cavity. Mucous membrane of nose healthy. Patient has been entirely free from pain since last catarrhal attack, April 7th. There is still a small relative scotoma.

The above case has been one of great interest to me, because it has thrown additional light upon a large class of unfortunate cases, *i. e.*, retrobulbar inflammations.

Let us for a moment look at Fig. 3 and try to explain the symptoms:

1. Dull pain on left side at intervals for a year or more, aggravated by colds.

Due to inflammation in left sphenoidal cavity, with retention of pus when ostium sphenoidale was closed by swelling of the mucous membrane and swollen turbinated bodies.

2. Neuralgia of 1st div., 5th, gradually becoming intense and constant.

Cause.—Extension of inflammation through thin, bony walls of sphenoidal cavity into sphenoidal fissure, causing first irritation, then pressure on the 5th nerve.

3. Visual disturbance, slowly increasing to total blindness.

Cause.—Inflammation extending from sphenoidal cavity through bone of "paper thickness" to optic nerve. Reduction of calibre of ophthalmic artery for same reason.

4. *Exophthalmus and Congestion.* Caused by inflammation in sphenoidal fissure, and strangulation of ophthalmic vein.

5. Movements of globes painful and limited.

Cause.—Inflammation, and pressure in sphenoidal fissure on 3d, 4th, 5th, and 6th nerves.

And lastly, rapid subsidence of all these symptoms upon relieving pressure and reducing inflammation in sphenoidal cavity and fissure.

CASE B.—*Unrecognized Empyema and Necrosis of Sphenoid; Visual Disturbance; Cerebral Hemorrhage. Death. Autopsy.*

During the past twenty years patient, Mr. Isler, had suffered from marked nasal obstruction. Only breathed through the nose with great difficulty, and was obliged to sleep with his mouth open. There was never at any time profuse discharge from the nose or excessive expectoration, not even in the morning upon arising. Did not suffer much from headaches until about four years ago, when he had a severe attack of the Grippe. At that time his eyes began to trouble him.

Upon examination I found a moderate error of refraction, which, with correcting glasses, gave perfect vision. Ophthalmoscopic examination negative. Attacks following the Grippe were never constant, but much aggravated, whenever he would have a fresh cold. During such periods, he complained of pain in the temples and deep behind the eyes and in the top of the head. Two months ago suffering became very severe, with increased asthenopic symptoms.

A rest of four weeks gave him but little relief. In fact at one time during this period he was unable to read fine print although vision was good for distance. Upon returning to the city his eyes were again carefully examined, but, excepting an increased weakness of the ciliary muscle, vision was perfect. Ophthalmoscopic examination absolutely negative. He was, however, morose. Given much to talking about suicide, but appeared physically perfectly well. Thus far he had come to the office only for treatment of his eyes, but the nasal obstruction became so excessive that he was willing to receive treatment for it.

Examination revealed ears normal. Nose—both nostrils free from pus, but practically occluded by the enormous swellings of the turbinateds, which were of deep-red color. Pharynx congested, but free from pus.

I removed some of the pendulous hypertrophied tissue from the inferior turb. on the right side; this was followed by free bleeding (the bone was not touched). This seemed to give him great relief, and he expressed himself as highly pleased, feeling much lighter about his head.

The wound healed very quickly without the slightest evidence of inflammation, and the patient had made arrangements to have the other side operated upon, when he was suddenly seized with intense pains in the head and slight fever; was attended by his family physician, Dr. Knott, but expired about 12 hours after the onset, with symptoms of cerebral hemorrhage.

I was especially anxious to secure an autopsy, first because the intense pain in the head and asthenopic symptoms, extending over several years, associated with the sudden death, pointed strongly to intra-cranial disease. But death coming on so shortly after an operation, even if slight, would always leave a doubt as to whether or not the latter in any way influenced the fatal termination, but, as the post-mortem result showed, this had nothing to do with it.

Post-Mortem Notes of Mr. Isler, March, 1894.—Four hours after death. Appearance of face normal. Patient unusually well developed and nourished. Upon removal of calvarium, brain found normal in appearance; when removed, a blood clot was found covering the area of the sella turcica, anterior clinoid process, and optic chiasm, extending forward towards the cribriform plate. (See Fig. 1, where I have outlined the clot upon another specimen.) This remained as an elevated soft mass. All of the clot was apparently very recent, as indicated by the color and consistence. Gently removing the superficial portions of the clot, in order to determine the outlines of the sella turcica and sphenoidal body, it was found that the dura and bony roof over the sphenoidal cavity had been entirely destroyed, *and with the finger one could pass directly downwards to floor of cavity without encountering any obstruction save the clot and the puriform secretion mixed with a gritty substance which denoted the broken-down bone tissue.* The floor of the sphenoidal cavity was denuded of periosteum and superficially eroded. All of the sella turcica had been eroded, and none of the processes existed, the necrosis having also destroyed a considerable portion of the basilar process, so that one could easily break down this portion by simply scraping it with a knife. Anteriorly, one was able to scrape away the partially necrosed lesser wings of the sphenoid, even up to the cribriform plate.

The ethmoidal sinuses were filled with thick pus, and the bone was of a greenish-black color. The anterior wall and the floor of the sphenoidal cavities were very thick, which probably explains why the disease extended upward instead of downward into the nose. From the location and appear ance of the clot, it was evident that a vessel in the region of the cavernous sinus had become eroded and ruptured, thus leading to the rapid and fatal termination.

The hurry and unfavorable light under which the post-mortem was made prevented a more careful search for the rupture. The only part of the brain which appeared to be affected was the pituitary body. There was no exudation of lymph at any point, and no meningeal affection, excepting in the immediate neighborhood of the necrosed ethmoidal and sphenoidal cells; there the dura was macerated, and in places absent.

While abroad in 1894 the following case came under the care of my assistant, Dr. D. T. Vail, and I have made a brief abstract from his notes of the case, but give Dr. Freeman's post-mortem notes in full:

CASE C.—*Empyema of Sphenoidal, Ethmoidal, and Frontal Sinuses; Cerebral Abscess. Death. Autopsy.*

History.—Fred Johns, aged fifteen. Six weeks ago, a severe headache came on, accompanied by swelling over the right eye Four weeks ago, Dr. Prugh lanced it under right eyebrow, evacuating pus. One week later, patient had severe convulsions, proptosis, and diplopia. At first, no optic neuritis. Later the right optic nerve was inflamed, and about July 1st the left also showed signs of inflammation. Headache incessant. Hypertrophy of turbinated bodies, but no polypi or excessive secretion. Pain located over the right eye, temple, and occiput. Examination of ears negative. Operation advised, but refused. Died. July 23d.

Autopsy, July 24, 1894.

Present—Drs. Vail, Prugh, Watson, Freeman.

"On removal of brain the right frontal lobe was found considerably enlarged anteriorly, and boggy to the touch. On its inferior surface were a number of miliary abscesses the size of a pinhead grouped together in an area 2½ *cm* in diameter. An incision into the swollen lobe revealed an abscess containing at least two ounces of thin yellow pus, having a greenish tinge and a very offensive odor. The adjacent brain tissue was much softened. There was no suggestion of an abscess wall, so that the abscess was evidently of quite recent origin, this idea being supported by the presence of the miliary abscesses. The layer of brain substance, between the pus cavity and the orbital and cribriform plates, was quite thin. The periosteal tissue over the right orbital plate was entirely loosened, and the plate eroded, at its superior aspect, at one place being entirely absent over a small surface, the bone being replaced by fibrous tissue. There was no direct communication with the orbital cavity, although there probably had been at some previous time a small scar, indicating where pus had found its way externally. The cribriform plate on the right side was necrotic and almost black in color.

The ethmoidal cells were largely denuded of their lining membrane, the bone being superficially necrotic in places. The sphenoidal cells were also diseased. The bone lesion being evidently of much older date than the brain abscess, the former probably occurred first, the abscess being of secondary and recent origin."

(*Signed*) LEONARD FREEMAN, M.D.,
Pathologist, Cincinnati Hospital.

Strict classification would not place this case in my present paper, as there is no doubt that the fatal result was due to an extension from the ethmoidal cells and frontal sinuses resulting in erosion of the upper plate of frontal sinus over orbit. This plate (see *P* in Fig. 3) is frequently only the thickness of paper, and the cavity often extends over the orbit back to the optic foramen; I however placed it here because the sphenoidal cavity was also diseased, and the history and post-mortem notes make it an instructive case.

MALIGNANT GLAUCOMA: REPORT OF A CASE TERMINATING IN RECOVERY.

By HARRY FRIEDENWALD, A.B., M.D., of Baltimore, Md.

THE subject of this paper is one of great importance. It is especially interesting to those who have met with disastrous results after operations for simple glaucoma; for personal experience only can make one appreciate the fearful disappointment of meeting with malignant glaucoma when looking forward to relief,—of producing painful and incurable blindness instead of preserving sight.

We find scattered through the literature of the past quarter of a century numerous references to this affection, but most writers have either copied or abridged the original description given by von Graefe or else have made isolated observations without reference to those of others.

In the study of a disease so rarely met with as the affection under discussion, it is essential that the observations of numerous observers should be collected and compared. The first part of the paper will therefore be made up of an historical survey of the subject.

History.

Von Graefe,[1] in discussing the pathology and therapy of glaucoma,* described an affection which he had witnessed as a result of an iridectomy in cases of simple glaucoma, and which he termed "the malignant course." He had seen this condition five times in several hundred cases of iridectomy. He was of the opinion that less than two per cent. of the cases of simple glaucoma in which an iridectomy is made take on this malignant form. Von Graefe says that if we

* References will be found at the end of the article.

palpate eyes after iridectomy in cases of simple glaucoma we shall find varying degrees of tension within the first few days or even immediately after the operation. In this respect there is a marked difference between the behavior of eyes affected with acute inflammatory glaucoma and those suffering from simple glaucoma. Some of the latter are as soft or even softer than the average normal eye; while others become harder than would be normal even in an eye that had not been incised. In the latter case we must not expect the rapid reappearance of the anterior chamber; even if the tension of the eyeball is not excessive though considerably higher than that of a normal eye that has been punctured, the anterior chamber may not be re-established before the third or fourth day after the operation, or even later.

In the worst cases the pressure increases during the first few days and the iris and lens are pressed firmly against the cornea. The cornea becomes somewhat hazy, there is increased lachrymation, and a peculiar pericorneal injection makes its appearance; the latter is characterized by greatly dilated conjunctival veins which are bent at angles and are seen to unite with episcleral vessels that are likewise dilated. The eye becomes sensitive to the touch, especially in the part where the incision was made. The patient complains of more or less ciliary neuralgia and of sleeplessness, and sight is gradually destroyed.

The chief danger, when the anterior chamber does not become re-established, *lies in the increasing tension associated with signs of inflammation.* When the latter, namely, sensitiveness to palpation (not the spontaneous ciliary neuralgia due to the increased tension), tearing, marked congestion, do not arise, the danger is somewhat lessened. In such cases, diminution of the tension usually occurs after a few days; even when the anterior chamber does not become re-established before the second week or even later, the case may take a favorable course. If there is no irritation whatever and the tension is but slightly increased, we may surely expect that after a few days the first, usually very shallow layer of aqueous humor will make its appearance, and somewhat later still that there will be perfect restitution of the anterior chamber.

There are all gradations from the most malignant forms to those last described. Though only at most two per cent. suffer with intense malignant glaucoma, about ten or twelve per cent. show slow re-establishment of the anterior chamber (after second day), with somewhat increased tension. About one half of these cases present signs of irritation; for the most part these are slight and disappear after the re-establishment of the anterior chamber and the reduction of the tension. Some of these, however, result in incomplete reduction of the tension, and the tension, may even show a subsequent increase.

The malignant course is varied. The irritation and the tension may constantly increase during the first few days after the operation and the eyeball become of stony hardness while vision is completely extinguished. The hazy condition of the cornea and vitreous prevents an ophthalmoscopic examination. After a number of weeks the tension diminishes and a shallow anterior chamber is formed, but the function of the eye remains irreparably lost. At this time the ophthalmoscope will show diffuse, fine opacities of the vitreous, sometimes even detachment of the retina.* In other cases, even though the tension becomes reduced, there is permanent absence of the anterior chamber, due to the firm union between the iris and the cornea. In other cases still, in which the signs of irritation never become very marked, vision is slowly lost, the field of vision being gradually contracted, as in cases of progressive glaucoma.

Von Graefe believed that the operation in these cases sets up an acute glaucomatous attack, differing from the usual picture only because of the absence of the anterior chamber. The sensitiveness to pressure in the ciliary region near the seat of the wound led him to conclude that the process results from irritation of the ciliary body. He had observed the occurrence of the malignant course, even the mildest described above, only in simple glaucoma without periodic cloudiness of the media; there was but one exception,—a

* V. Graefe mentions incidentally that puncture of the vitreous had been made in one of these cases.

case of secondary glaucoma from dislocation of the lens. In all of his cases the tension before the operation had been quite high. But he could find no cause for the malignant attack either in the mode of operation or in the individual conditions of the patients. It is worthy of mention that Graefe thought that sympathetic ophthalmia may arise as a consequence of this affection (?).

His case (1) is very remarkable. The left eye of an adult male was operated upon for well marked simple glaucoma. The anterior chamber was re-established on the seventh day; the increased pressure had become reduced about the fourth or fifth day, and there had been but slight signs of inflammation. The further course was favorable, for, though the tension remained a trifle increased, the vision, which had previously rapidly diminished, now remained stationary. Half a year later the patient returned for operation on the right eye. This was followed by a severe malignant glaucoma, and during the second week the left eye became involved. Both eyes suffered progressive and finally complete loss of sight, with the clinical picture of a glaucomatous inflammation modified by the absence of an anterior chamber. Graefe calls attention to the tendency to a malignant course in the left eye after the first operation.

This case was regarded by von Graefe as sympathetic. Most ophthalmologists will now agree with us in not adopting this view. We shall see below that in other cases malignant glaucoma resulted in an eye previously operated upon after an operation upon its fellow, and we are therefore led to regard this case as a malignant glaucoma induced by an operation or by a malignant glaucoma of the fellow eye. This case also illustrates a fact to which we shall call attention later on,—*that the tendency to malignant glaucoma is bilateral.*

I have given this rather lengthy abstract of von Graefe's description of malignant glaucoma because it is the first and by far the very best and clearest that I have found. He calls it "the malignant course." It is this affection which has since been known as "*glaucoma malignum.*" Some writers have somewhat confused the picture by including

under the term " malignant glaucoma " other, entirely different, though likewise unfortunate, results of the operation of iridectomy, such as severe intraocular hemorrhage. This confusion of clinical pictures must be pointed out when such a distinguished authority as Schweigger, to whose writings we owe so much, describes both affections under the title of glaucoma malignum in a recent number of these ARCHIVES.

In this paper we shall follow others in calling the affection malignant glaucoma, rather than " a malignant course," even though our understanding of the pathology is much veiled. There appears, however, to be a distinctive and peculiar pathological condition set up by the operation, and this significant name has been universally accepted in both the English and German languages.

In the same year (1869) that the above article appeared, a discussion of the subject took place at the meeting of the Ophthalmological Society at Heidelberg.[3] The discussion followed a paper of Adamuek on intraocular pressure.

Meyer, of Paris, stated that in some rare cases of iridectomy there is no diminution of tension after the operation. In the more fortunate the anterior chamber becomes re-established in from two to three days, and then the tension becomes diminished ; but in others the tension remains increased for three or four days and the result is frightful.

Becker and Horner agreed that those cases in which the anterior chamber is very slowly re-established are the least favorable.

Mauthner stated that in acute inflammatory glaucoma the iridectomy was sometimes followed by the absence or scant re-establishment of the anterior chamber, and yet that the resulting vision was excellent and permanent.

Liebreich called attention to the fact that there was but one sign that could be looked upon as unfavorable, namely, when the eyeball is of stony hardness after the aqueous humor had been allowed to escape.

Berlin had seen a case (2) of this kind and extracted the lens, which relieved the pain.

Nagel described two cases, and believed that the malignant course is due to hemorrhage. His first was the case

(3) of a boy aged ten who had had traumatic glaucoma for several years, which had set up sympathetic ophthalmia. An iridectomy was made, the eyeball remained hard; after a few weeks the eyeball was enucleated and a large fresh blood-clot was found. In a second case (4) the eyeball became very hard during the operation, and in a few moments the vitreous was discharged by a hemorrhage. It is improbable that this was a case of malignant glaucoma.

Reuss stated that he had seen four cases of malignant glaucoma, all of which ended in amaurosis. One of Reuss's cases of malignant glaucoma occurred in a patient with chronic inflammatory glaucoma (5).

Hirschberg, in 1874, described an interesting case (6) of malignant glaucoma.[a]

Mrs. H., aged fifty-one, had an iridectomy made upon the left eye for simple glaucoma; the eye was lost through malignant glaucoma. Two days after the operation sight of the right eye became blurred. Repeated punctures of the anterior chamber afforded but transitory relief; in the course of a few weeks the patient was unable to walk about alone. The patient was examined at this time by Hirschberg. The right eye, which could count fingers at six or eight feet, showed slight increase of tension, a somewhat dilated and irregular pupil, a very shallow anterior chamber, deep excavation of the papilla without arterial pulsation. After the iridectomy was made, T + 1, being somewhat higher than on the day before the operation and much higher than is usually found after an iridectomy. A light bandage was applied, and the very same day there was slight re-establishment of the anterior chamber. On the following day the iris was pressed up against the cornea, there was a pericorneal injection, T + 1, but no pain. The patient was bled and galvanization was applied to the cervical sympathetic (to reduce the vascular pressure) without effect. The wound healed, but no anterior chamber was formed, and sight was completely lost.

We have detailed this history because it illustrates several important points. The first is the tendency of both eyes to suffer the same result after an iridectomy. The second is the fact that the puncture, made more than once before the iridectomy, did not produce malignant glaucoma. We shall

also point out the important fact that the anterior chamber was partially re-established a few hours after the operation and then became empty and remained so.

In 1876 Ispert published an inaugural dissertation [4] upon the question whether the iridectomy for glaucoma may be injurious. He discusses the subject of malignant glaucoma without adding anything new to it.

Schmidt in *Graefe-Saemisch's Hand-book* (1877 [5]) devotes a chapter to malignant glaucoma. This consists of a brief extract of von Graefe's description, and references to a few cases published by Mauthner, Berlin, and Hirschberg.

Schmidt does not contribute anything new to our knowledge of malignant glaucoma. Concerning the therapy he adopts von Graefe's suggestion not to use a pressure-bandage but to close the lids with a plaster strip when the eyeball is hard after an iridectomy. He considers morphia and narcotics indicated for the pain, and states that atropia should not be used. Venesection, depletion, quinine in large doses are mentioned, but he frankly states that therapy appears powerless in this affection.

Schweigger, in a lecture on glaucoma,[6] published in 1877, gives an accurate description of malignant glaucoma. He had at that time seen six cases * (7, 8, 9, 10, 11), all females. Simple glaucoma with rather high tension had developed first in one eye, the other being perfectly normal. In all of these the disease began about the beginning of the climacteric period or somewhat earlier. He regards these facts as of prognostic importance. Later publications, as we shall see, confirm the truth of these observations. He was of the opinion that the affection could not be ascribed to emptiness of the anterior chamber because he had observed in all cases of glaucoma with high tension for some time before the operation (whether with or without inflammation), that the iridectomy was followed by emptiness of the anterior chamber; this might last for seven or even fourteen days without injury.

The next contribution of importance is that of Weber,[7] published in the same year, 1877. In discussing his theory

* One of these cases is identical with Case 6 of Hirschberg.

of glaucoma he states that malignant glaucoma is to be attributed to a dislocation of the lens forward, into the space between the iris and the ciliary body. This theory is based partly upon a case (12) which he examined anatomically. An iridectomy was made upon the left eye of a woman suffering from simple glaucoma. No improvement of vision followed. Four weeks later the sight of the right eye rapidly diminished. An iridectomy was then made on both eyes, in the left eye diametrically opposite to the first. No anterior chamber was formed in either eye. There was opacity of the media, and while the tension was not very high, the anterior ciliary vessels were markedly congested. Vision was reduced to perception of light. The left eye was enucleated. A dense flesh-colored mass was found lying between the sclera and the choroid, composed of a dense mass of minute leucocytes. The equator of the lens was wedged between the ciliary body and the iris. The retina was completely detached. He would ascribe all the symptoms to the mechanical displacement of the lens, and seeks to relieve the condition by an operation, whose object it is to reduce the dislocation. *This operation consists in the puncture of the sclera with a broad-furrowed needle about eight or ten mm from the corneal margin; he then presses either with the finger or, when the patient is anæsthetized, with a spoon directly upon the cornea, at first gently and then with more force in a direction perpendicular to the surface of the coloboma, toward which side he believes the lens to be usually dislocated. After pressing for a minute or a minute and a half the pressure is relieved.* He speaks of the operation in the most sanguine manner, but states that it is to be done between the *tenth and twentieth day after the iridectomy*, and that he had never tried it while the wound was still open.

At the meeting of the Ophthalmological Society at Heidelberg,* in 1877, Pagenstecher described a number of glaucomatous eyes which had been enucleated; among these there were two with malignant glaucoma (13, 14). In both of these he attributes the condition to the *lens being pushed far forward into the wound and partly carrying the ciliary process along with it.* He believes that the lens in this way irritates

the ciliary body and the iris, and at the same time closes the point of drainage made by the iridectomy.

Schweigger combated the mechanical theory as to the origin of malignant glaucoma on the ground that there are many cases in which the anterior chamber does not become re-established for a week or two and where the relative anatomical position of the lens is the same as in malignant glaucoma, but which show no inflammatory symptoms, and in which the anterior chamber gradually becomes re-established.

Hirschberg mentioned that he had seen malignant glaucoma occurring in a case of hemorrhagic glaucoma in a diabetic patient (15). After a few weeks he extracted the lens and allowed a little vitreous to escape, and the eye became perfectly quiet.

Arlt thought that the extraction of the lens ought not to be done in malignant glaucoma because of the great danger of hemorrhage, which would destroy the eye. He confirmed Schweigger's statement that females are predisposed to malignant glaucoma.

Samelsohn related a case of a man with simple glaucoma (16) in both eyes. The left eye was operated upon; immediately after the operation the eyeball was soft, but increase of pressure soon followed, lasting for three days with no anterior chamber, then sank while the anterior chamber became re-established, and in three days the patient was allowed to leave his bed. On the following day the second eye was attacked with acute glaucoma and the sight was lost, even though a second iridectomy was made opposite to the first. He assumed that an acute attack of glaucoma was about to commence in the second eye and that the operation did not prevent its occurrence (?).

Schweigger had seen a case of subacute inflammatory glaucoma in which acute inflammatory symptoms arose eight weeks after iridectomy; notwithstanding a second iridectomy, acute symptoms again made their appearance, and the eye was lost. This case, however, has little resemblance to malignant glaucoma.

In his statistical article on the prognosis of operations for

glaucoma, Hirschberg, in 1878,[9] mentions two cases. One is the case described above and was published in 1874; the other (17) is that of a female aged forty-three with simple glaucoma; the condition was absolute in the right eye and well developed in the left, with which she could still count fingers at four feet. An iridectomy was performed on both eyes at one sitting. The anterior chambers did not reappear; there was some pericorneal injection and tearing. One month later the anterior chambers were very shallow and vision worse than before the operation; (could count fingers at 1½ feet). Hirschberg describes the condition as a "subacute malignant course."

Reuling in the same year described [10] the case of a woman (18) aged about forty-five with "*glaucoma inflammatorium chronicum consummatum in the left and glaucoma simplex in the right eye.*" An iridectomy was performed at the same sitting on both eyes. During the night the patient had an attack of angina pectoris and intense pain in and about the eyes. When the bandage was removed both eyes were found to be extremely congested, the lips of the incisions were gaping, and the upper margins of both lenses protruded through the wound. In about fourteen days both wounds were perfectly closed. V = 0. The lenses were not removed.

In the discussion on operations for glaucoma at the International Medical Congress, held in London in 1881, Knapp [11] in comparing sclerotomy with iridectomy said that the former operation is less frequently followed by malignant glaucoma than the latter.

In 1884, McHardy read a paper on "Clinical observations which appear to indicate a means of reducing the danger from malignant glaucoma while increasing the efficacy of iridectomy in the treatment of primary chronic glaucoma," before the Ophthalmological Society of the United Kingdom.[12] In chronic glaucoma he makes an incision similar to that made in extraction and with a narrow knife. In one of 30 cases operated upon in this manner, the lens escaped spontaneously twenty-two hours after the operation (19). There was no loss of vitreous and the course of healing was favorable.

In another case (20) of recurrent subacute glaucoma in which an iridectomy had been made without effect, a second iridectomy below resulted in the escape of the lens with its capsule but without the escape of vitreous. The course and result were normal.

Jacobson pointed out in 1884[13] that in simple glaucoma careful observation will often show signs of great venous congestion in the anterior portion of the choroid though externally the eyeball may appear perfectly free from such congestion. Such signs are the appearance of marked ciliary congestion (annulus arthriticus) when the patient is narcotized, due to the diminished cardiac power and vascular pressure, while in other cases the entire eyeball becomes covered with a fine network of congested subconjunctival vessels. In many cases the iridectomy is followed by great hemorrhage into the anterior chamber, especially when the incision is very peripheral. These manifestations all point to great congestion of the anterior section of the choroid. He therefore explains the occurrence of malignant glaucoma in the following way. The operation is followed immediately after the first diminution of pressure from the escape of aqueous humor by great venous congestion with transudation. The iris is pushed forcibly against the cornea so as to prevent re-establishment of the anterior chamber and to close the spaces of Fontana; the result is the development of an acute œdema under the picture of malignant glaucoma. He relates the case (21) of a man aged seventy-two; both eyes appeared normal, no dilated vessels externally, anterior chambers shallow, pupils contracted and normal in reaction; the media were clear, papillæ white, the larger arteries narrowed, the veins somewhat dilated; the upper half of the papillæ was excavated and the large vessels sharply broken at the edge. V R E $\frac{20}{30}$, V L E 1, T + 2. On account of a large defect in the field of vision reaching to the point of fixation, a sclerotomy was performed on the right eye. The characteristic annulus arthriticus mentioned above made its appearance; the sclerotomy was normal, but the anterior chamber was immediately filled with blood. On the following day œdema of the conjunctiva made its ap-

pearance; tension + 3. Four weeks later blood absorbed; tension + 2. Two months after the operation there was not the slightest perception of light; media clear, small hemorrhage in retina, papillæ completely excavated. The left eye was treated with pilocarpin and its condition remained unchanged.

Jacobson subsequently published a number of important observations which we shall put together below.

In 1886 Javal described a case of malignant glaucoma (22) at the meeting of the Ophthalmological Society at Heidelberg.[14] The case was one of simple glaucoma with scarcely perceptible increase of pressure. A sclerotomy was performed and an iridectomy soon after. The last operation was followed by increase of pressure, ciliary neuralgia, and absolute loss of sight. In the discussion that followed, Fuchs stated that in one of his cases of malignant glaucoma (23) he made a sclerotomy at about the equator with a Graefe knife. No vitreous appeared at first, though the wound was rather long. It was only after a few days that a gelatinous protuberance developed under the conjunctiva at the point of incision. Vision rose to about $\frac{6}{24}$ and the field of vision became enlarged. But the anterior chamber was never re-established. In this case the iridectomy had been followed by a typical and most intense malignant glaucoma, with absence of the anterior chamber, dull hazy cornea, diminution of sight until fingers could be counted only at a short distance. Myotics were used without avail, and the sclerotomy was performed six weeks after the iridectomy.

Javal stated that he had likewise performed a sclerotomy in his case, but without any improvement of vision.

Rheindorf[15] in 1887 described his theory of glaucoma as being the expression of an interference in the passage of the fluids of the eye from the posterior into the anterior portion, due to an increased density of the lens and zonular diaphragm. He found the proof of this in the result of the extraction of the lens with rupture of the cup-shaped depression of the vitreous in cases of malignant and of absolute glaucoma. He declared that he had perfect success in

eleven cases, and, contrary to expectations, there was never any hemorrhage into the vitreous.

Masselon, in an article on equatorial sclerotomy published in 1888,[16] reports the results of a transverse puncture of the sclera just back of the ciliary body with a Graefe knife, in cases in which iridectomy was without effect or had even produced injurious results, as well as in absolute glaucoma. In most cases the pain diminished, the cornea became clear, the congestion of the vessels was reduced, and the anterior chamber again made its appearance. In the discussion that followed this paper, Vacher stated that he had twice seen staphylomata develop as the result of this operation.

De Wecker said that he had succeeded in making corneal staphylomata disappear by this operation; still his confidence in the operation was not very great.

Laqueur, in an article on "Glaucoma in Youthful Individuals," published in 1889,[17] describes a case (24) of subacute glaucoma with increasing intensity, first attacking one and then the other eye. An iridectomy on both eyes was followed by the very late reappearance of the anterior chamber in the first eye; the anterior chamber was not reestablished in the second eye. Parenchymatous opacities, posterior synechiæ, with deposits upon the membrane of Descemet and upon the anterior capsule, developed later on. Laqueur does not consider the case as one of primary glaucoma, but as an insidious irido-cyclitis, beginning with the picture of glaucoma. We cannot refrain, however, from including this in the list of cases of malignant glaucoma.

In 1889, in the discussion that followed Dr. Bull's paper on glaucoma before the American Ophthalmological Society, Dr. Knapp stated[18] that he had seen four cases of malignant glaucoma in 226 operations for chronic glaucoma. In two cases both eyes were lost; one of these (25) was a female, aged forty-five; glaucoma was well developed; contraction of visual field was marked; there was a distinct excavation. An iridectomy was performed on both eyes, and both eyes were lost by malignant glaucoma. In the second case (26) the patient was an old lady with atheroma-

tous arteries. Both eyes were lost after the iridectomy, and inflammatory attacks recurred. One of the wounds opened and a mass of ciliary body protruded. This was removed, and then the eyeball became shrunken. In two other cases (27, 28) there was but one eye lost by malignant glaucoma.

At the following meeting of the same society[19] in 1890, Dr. Kollock reported the case (29) of a female, aged fifty, who had recurring attacks of neuralgic pain and simple glaucoma. Vision $\frac{15}{20}$, tension +1, anterior chamber shallow, discs deeply cupped, arteries pulsating. Two days after the iridectomy, T. rose to +3; eserin was instilled without benefit, and in two days vision was completely lost. He then used a strong solution of eserin, instilling it hourly; this was followed by the rapid diminution of tension and by the return of vision, the anterior chamber regained some depth, the pupils contracted slightly, and pulsation of the arteries ceased.

In Schweigger's article on "Glaucoma and Affections of the Optic Nerve," published in 1891,[20] we find some very important and interesting references to the subject under discussion, together with the report of a number of cases; these were the same cases which were mentioned in the reference of 1877 (Cases 7–11). He calls attention to the fact that though a paracentesis wound healed in a normal manner with re-establishment of the anterior chamber, an iridectomy on the same eye a few days later was followed by severe malignant glaucoma, which prevented union of the wound for almost a month. This case is adduced as a proof that it is not the evacuation of the anterior chamber which is the cause of the malignant glaucoma. The anterior chamber was immediately filled after the paracentesis, but remained empty a long time after the iridectomy. Basing his statements upon those cases that had occurred in his own practice, as well as those which he had not himself operated upon, he laid stress upon the following important fact:

"*When glaucoma malignum attacks one eye, it follows iridectomy on the other eye, even when the second is not affected for years after the first.* The cause of the unsatisfactory

results of the operation must lie in some obscure structural anomaly inherent in the eye itself. Experience teaches us that in all cases of chronic glaucoma affecting both eyes *it is advisable to first operate upon the worse one, even if it be absolutely blind. Should this be followed by the normal healing process, the second eye may be operated upon without the least apprehension.*"

In 1894, Rosenberg published an inaugural dissertation [31] on glaucoma malignum in which he reported one of Hirschberg's cases, and also made a partial review of the subject. The case (30) referred to is so important that we shall give an abstract of it here.

A female, aged thirty-four, had had frequent attacks of severe pain associated with gradual diminution of vision, for about one year. R E $\frac{1}{5}\frac{5}{5}$, field of vision normal, perception of colors normal. L E $\frac{1}{2}\frac{5}{0}\frac{}{0}$, field of vision greatly contracted. R E no inflammation, T + 2, episcleral veins full, transparent media clear, retinal veins distended, beginning excavation, arterial pulsation. L E similar, tension perhaps a little higher, excavation of papilla complete, pupil medium and reacts to light. Physostigmin (1 per cent.) was used in the L E, the pupil became narrow, tension was lower than in the better eye. An iridectomy was made on the left eye. The anterior chamber did not fill immediately, but was re-established after a few days and sight improved. The right eye was therefore treated in the same manner; the tension after the operation was reduced less than usually, the anterior chamber remained empty; the eye was not inflamed for a week; then the irritation and pain set in, and on the following night the other eye likewise became inflamed, and the anterior chamber disappeared after having been present for ten days. This rapid change occurred simultaneously with the onset of menstruation, a condition which had always been attended with severe headache. Vision rapidly diminished in both eyes.

Weber's operation was performed at first upon the left eye. A little vitreous was forced out and the tension was diminished. In the evening the tension was almost normal, some aqueous humor was present, and there was slight vision. The improvement of the eye was followed by improvement in its fellow. Almost four months afterward the patient returned. The condition of the right eye had become very bad, and Weber's operation was performed

upon this eye. Patient was seen seven years later. Both eyes were free from irritation, and the cicatrices were smooth. In the right eye there was slight light perception, tension was increased, and the anterior chamber was absent. There was a band-like opacity over the cornea. The vision of the left eye and the visual field were better than before the first operation ; the patient could read Snellen 50 at 15 feet. Tension about normal, media clear, papilla excavated, posterior synechia.

We have given this case in detail for three reasons. The first is that it is the only one reported in which the Weber operation was followed by permanent restoration of vision. The second, that the critical change in both eyes occurred simultaneously with the onset of menstruation and appeared to be intimately connected with it. The third reason is that the malignant glaucoma of the eye first operated upon did not begin before malignant glaucoma was set up in the second eye. After the anterior chamber had been established for ten days it disappeared spontaneously.

In the *Fuenfundzwanzigjaehriger Bericht* [22] of his hospital, Hirschberg in 1895 states that he has seen five eyes affected with malignant glaucoma among two hundred and eight eyes operated upon for simple glaucoma. He always operates upon the worse eye first, even if it is completely blind; this serves him as a guide to the operation of the other eye, for he discovered early that the idiosyncrasy affects both eyes. He describes a case (31) of a girl aged seventeen who had been operated on both eyes ; the anterior chambers were absent, papillæ pale and deeply excavated, and the eyes were irritated. (This case will be mentioned below under reference to Schweigger.)

Hirschberg has performed Weber's operation four times (three patients) ; in one eye the result was successful and permanent,—the only one known to him in his practice or in literature. This is the case which Rosenberg described and which is given above. He is inclined to lay stress upon menstruation as a factor in the production of malignant glaucoma.

In 1895, Adamuek [23] published a paper upon malignant glaucoma. He describes two cases.

His first case (32), the description of which is very unsatisfactory, was a male aged thirty-four, whose blind right eye was first operated upon; this was followed by severe malignant glaucoma, which repeatedly caused the wound to open and produced prolapse of the iris; the wound finally healed and tension became normal. Six weeks after the first operation attacks of subacute glaucoma affected the other eye, and vision rapidly diminished. The iridectomy was likewise followed in this eye by malignant glaucoma, the wound opening and closing several times; there was constant pain, and vision was rapidly lost. In this eye there was also considerable iritis.

His second case (33) was a female aged fifty-two with simple glaucoma, complete in the left eye and slightly developed in the right eye. The tension in this case, as well as in his first, was very high. An iridectomy was done on both eyes at the same time, and this was followed by considerable hemorrhage in both anterior chambers. The operation was followed by pain, which persisted for many days, and on the third day after the operation the tension was very high and the anterior chambers were entirely absent, which condition persisted for more than two months. In this case iridectomies were subsequently performed, with improvement of one and aggravation of the other eye. After a number of months the irritation diminished; there was a tendency to atrophy of the eyeball and vision was absolutely lost. He makes the statement that in many hundred cases in which he has performed iridectomy for glaucoma, he has seen but two cases of malignant glaucoma.

His two cases, however, taught him (what others have long before insisted upon) that in a case of malignant glaucoma occurring in one eye, no operation, or at most the puncture of the cornea, should be attempted in the other.

In the April number (1896) of these ARCHIVES there is a translation of the very interesting article by Schweigger[34] on malignant glaucoma, together with the report of several cases.

In the case (34) of the first patient, a lady, whose left eye had previously been lost by malignant glaucoma, subacute attacks of glaucoma made their appearance in the right eye. Eserin giving no relief, and the attacks becoming more severe and of longer duration, thus diminishing central and peripheral vision, he was

forced to resort to operative interference. Iridectomy being out of the question, a sclerotomy was performed, for he was unacquainted with the fact that malignant glaucoma may follow sclerotomy. The operation was immediately followed by very intense inflammation; there was swelling of the lids and conjunctiva; hemorrhage in the tissue of the iris and in the anterior chamber; the pupil remained round, but was completely adherent to the capsule of the lens; the anterior chamber remained permanently empty; the scleral wound became ectatic; perception of light diminished; atrophy of the eyeball with complete blindness followed.

He therefore teaches that "*all that we can do in cases of malignant glaucoma of one eye when the other eye becomes affected is to use eserin or pilocarpin in order to postpone the blindness as long as possible.*"

He next relates the case of Miss S., aged seventeen (same as case 31 of Hirschberg), both of whose eyes suffered from malignant glaucoma, the operation having been performed on both eyes at the same time. The sight of the left eye was almost completely lost. The anterior chamber of the right eye was almost completely empty, but vision was $\frac{1}{10}$-$\frac{1}{7.5}$ five months after the operation.

Four years later the condition of both eyes was the same, and sight of the right eye was still $\frac{1}{10}$-$\frac{1}{7.5}$. This case serves to illustrate that an eye may show no signs of inflammation and vision continue unchanged, even though the anterior chamber remains empty.

The next case (35) illustrates the same point: A woman aged thirty-one had been operated upon by another surgeon for simple glaucoma. An iridectomy was made on both eyes at one sitting. Before the operation both eyes were free from irritation; there was decided increase of tension; the anterior chambers were normal; there were excavations of both papillæ. There was slight perception of light in the left eye. V R E $\frac{4}{12}$, with narrow field. The anterior chambers remained empty and tension remained high after the operation. Two months after the operation vision $\frac{1}{12}$, and field unchanged. A year later there was a very severe attack of glaucoma in the better eye, which improved under eserin. Almost a year after that there was a severe attack

of glaucoma in the worse eye and soon after a less painful attack in the better eye. These attacks reduced vision still more. When seen by Schweigger a year and a half later, the right eye could count fingers at 20 *cm*, and there was slight perception of light in the left eye, though both anterior chambers were completely empty.

The fourth case (36), a male aged sixty-two, with chronic glaucoma in the left eye. The field is very contracted, vision $\frac{6}{35}$, and deep excavation. An iridectomy in this eye was followed by absence of the anterior chamber. Vision became reduced, and in the second month after the operation the vitreous was punctured with a narrow knife. The anterior chamber became re-established and remained so as long as the scleral wound was bulged out by the vitreous, but after four weeks the scleral wound was firmly cicatrized and the anterior chamber again disappeared completely and vision was $\frac{1}{30}$.

Schweigger calls attention to the fact that it must be the increased pressure in the vitreous that prevents the re-establishment of the anterior chamber. He concludes with the following important statement: "The cases in which the malignant course occurs are for the most part chronic glaucoma; still I have seen the same malignant character in cases of intense glaucomatous inflammation."

Jacobson, in his numerous contributions on glaucoma, frequently refers to malignant glaucoma. On several occasions he refers to the peculiarities of the vitreous in different forms of glaucoma. Thus he states[25] that by palpating the eye after an iridectomy for simple glaucoma with a shallow anterior chamber and increased tension, he is able to distinguish a harder globular vitreous over which the sclera can be moved. He believes that the vitreous becomes smaller, denser, and contains less water immediately after the operation. He also says that palpation in acute glaucoma before and after the iridectomy does not show such a separation between the coat and contents of the eye. The tension is usually diminished slightly to rise soon afterward. If malignant glaucoma develops, which appears to be more frequent in cases of simple glaucoma, the tension increases until the eye becomes a firm solid body. If in this condition the sclera is

punctured beyond the equator with a needle or a Graefe knife, entering 4 to 6 *mm* into the vitreous, scarcely a drop of fluid escapes; if punctured with a broad needle to the depth of 12 or 14 *mm* and quickly withdrawn, two or three drops of a thick dark-yellowish substance escape without reducing the tension of the eyeball. The vitreous of the eye with malignant glaucoma is wanting in water, is a sticky substance of a dark-yellow color, and while apparently not larger than the normal vitreous is of increased density.[38]

This comprises all the references* we can find in literature to the subject. We shall now add the report of a case which has numerous important bearings.

Case of Malignant Glaucoma after Iridectomy for Simple Glaucoma; Cure; Recovery of Vision.

Mrs. R. W., aged forty-one, an otherwise healthy person, applied for treatment February 5, 1894. The left eye was blind, for how long she did not know; the pupil was irresponsive to light, but there was exquisite consensual contraction. There were no enlarged sclerotic vessels in this eye; the anterior chamber was of normal depth, media perfectly clear. There was a deep glaucomatous excavation of the papilla, reaching to the margin in all directions; a narrow glaucomatous halo surrounded the papilla. Most of the retinal veins were *very tortuous* especially those in the lower part of the retina. Several of the arteries were bordered near the papilla by white streaks. There were small hemorrhages toward the nasal side not far from the papilla and on the temporal side near the papilla; a large hemorrhage lay along the course of the very tortuous inferior temporal vein; the periphery of the retina was normal. This eye was at times painful. The tension was but slightly increased. There was slight convergent strabismus of this eye. The right eye was to all appearances normal; there was a typical physiological excavation of medium size. Vision very good. The only symptom of any importance

* The reader may notice the absence of references to Mauthner's treatise on *Glaucoma;* to Arlt's monograph on *Glaucoma;* to Panas's treatise on *Ophthalmology.* It was not without surprise that the writer found no mention whatever or but the briefest reference to our subject in the above mentioned and many other works. Nettleship in his address on the operations for glaucoma before the British Medical Association in 1895 does not refer to malignant glaucoma.

was that at times she had seen colored rings around lights; but it was not possible to determine whether she had seen these with the right or the left eye. Pilocarpin was instilled in the left eye for the relief of the slight pain; treatment was soon stopped.

February 10, 1894, the patient returned with a small central ulcer in the right cornea and my assistant instilled atropia. Hearing of it on the following day aroused the fear that an acute glaucoma might be produced in the eye in which there was a latent predisposition; but when she returned, though the pupil was dilated ad maximum, there was no disturbance whatever. Pilocarpin was instilled, but the pupil was not reduced for several days. *Not the slightest symptom of glaucoma made its appearance.*

February 27th, the patient was seen again. The right eye had recovered; there was but a small macula in the centre. The hemorrhages in the left eye had in great part disappeared; the only vein that was congested was the inferior temporal. August 9, 1894, the patient returned with slight pain in the left eye; an ophthalmoscopic examination was made and no changes were noticed in the right eye; the hemorrhages had been entirely absorbed in the left eye. I was therefore much surprised when the patient returned on May 15, 1895, to find a large excavation reaching almost to the margin of the papilla in the right eye. The vessels appeared normal, media clear, there was no pain, and she did not complain of increase of visual disturbance. The left eye was unchanged, excepting that the white perivascular sheaths in the left eye had increased. Tension was apparently normal, slightly less in the left than in the right eye. Tested with a chart with inverted E's, vision of the right eye was $\frac{6}{20}$, with $1 + D\ \frac{8}{15}$. There was a small defect in the nasal part of the field of vision. (Its apex reached to 30° from the point of fixation on the meridian 30° above the horizontal.) The patient was examined a few days afterwards and advised to have an iridectomy performed. Knowing the serious results that might follow, the patient was sent to Dr. Knapp, who had the kindness to examine the case. He wrote June 17, 1895, that "the case is clear; iridectomy in the right eye." On June 25th, a few days before the operation, the field of vision was again examined and the nasal defect was again found to be as described above.

June 27th, an iridectomy was made in the right eye under cocaine anæsthesia. The operation was performed without the

slightest difficulty and a perfect coloboma resulted; immediately after the excision a little blood appeared in the anterior chamber which obscured vision. The patient spent a comfortable day, and on June 28th the eye was examined in order to reassure the patient (who had become alarmed at the sudden loss of vision from the effusion of blood in the anterior chamber). The eye was white; the coloboma of the iris was perfect; the edges were entirely free, vision had returned; the anterior chamber was not re-established. She complained of her confinement in bed, and was therefore allowed to leave her bed for a short time in the afternoon of the 28th. During the evening and on the following day she complained of slight discomfort in the eye, and on the following day, June 29th, there was severe pain in the head. When examined, June 30th, it was found that the anterior chamber was still obliterated, the pupil moderately small, the eyeball congested, the conjunctiva chemotic, and tension + 3! Hot applications and eserin instillations were ordered, but on the following days the condition had gradually become worse; sight became worse every day. Eserin having no effect upon the pupil, it was for one day replaced by atropia (according to the advice of Jacobson), but this likewise, though frequently instilled, left the pupil unaltered. The iris was evidently wedged in so tightly between the cornea and the lens that neither myotics nor mydriatics would dislodge it. Ciliary sensitiveness became very marked. The pain continued without cessation. On July 1st three ounces of blood were extracted from the temple without relief. July 5th, eserin had been instilled without effect. Hot applications had been kept up day and night to relieve the pain. Atropin was again ordered. July 6th: By this time the vision had been reduced greatly, but the patient was still able to see the face of a person standing before her and see movements of objects, but was unable to count fingers. Salicylate of soda was now given in 20 gr. doses every three hours during the afternoon and evening and until midnight; nausea and depression then became so great that the salicylate had to be discontinued. The patient felt much better about the eye, and the condition began to improve. On the following morning she informed us that her sight had become clearer, and an ophthalmoscopic examination showed a reddish reflex in the pupil, the latter having appeared black for a number of days. What was more pleasing still was that the *tension which had been* + 3 *was now*

normal, and that the anterior chamber was in part re-established. The re-establishment of the anterior chamber was irregular; at first the iris was adherent to the cornea at a number of points. These adhesions rapidly disappeared; on July 8th, the anterior chamber was almost complete. There were two anterior synechiæ, one on either side of the pupil, and the iris began to dilate below and on the outer side. Salicylate of soda was repeated and atropia was continued and the appearance of the eyeball improved though the congestion was still intense. Day by day the condition improved, and on August 6th an accurate examination of her vision showed it to be little less than what was noted before the operation. In the meantime, the anterior synechiæ had disappeared. On October 24th the condition was as follows: right eye anterior chamber normal, nasal half of the iris of normal color (like that of the other eye), temporal half (especially in the smaller circle) discolored; the brownish color has disappeared; it is now a bluish gray. The coloboma is normal, there is a very slight contraction of the pupil to light and to accommodation. In the cornea there is the central macula (to which reference was made at the beginning of this history), and there were also brownish deposits especially in the outer part of the cornea, where the iris was adherent to the membrane of Descemet and where there is now the grayish discoloration of the tissue. There are posterior synechiæ especially in the outer part of the pupil; the excavation of the papilla is almost complete, reaching almost to the margin of the papilla, and the vessels are as previously described. The tension is quite normal, perhaps slightly less in the right eye than in the left. V $\frac{8}{30}$ without glasses; with + 0.5 s + 0.5 c Ax 180, V $\frac{8}{20}$ and $\frac{8}{15}$ partly. The field of vision is almost identical with that of May 15th; the slight variations are easily accounted for by the difficulty in getting the patient to fix the eye properly. December 2d an examination was made and tension was again found normal. The glasses mentioned above were worn with comfort. Vision unchanged and the field of vision practically as before. July 21, 1896, one year after the operation, the patient was again examined. V $\frac{6}{15}$, $\frac{6}{10}$ partly. Field of vision almost identical with that taken before the operation. No contraction has occurred. There is no ophthalmoscopic change. The excavation is large and deep, but there is a narrow ledge of nerve tissue still present, especially above.

It is clear in reviewing this history that the case was one of malignant glaucoma. The marked increase of tension, the complete absence of the anterior chamber, the gradually failing sight, the fixed pupil, unaffected by mydriatics or myotics, establish the diagnosis. It is therefore of the greatest interest that the termination was not such as almost always occurs in malignant glaucoma. Abstraction of blood, depletion of bowels, mydriatics, and myotics were not of the slightest service. The improvement took place very suddenly and followed so closely upon the administration of the salicylate of soda that it is difficult to avoid considering it as not only as *post hoc* but as *propter hoc*.

In conclusion, we may mention that inquiry was made as to the relation of the menstrual period to the outbreak of the malignant glaucoma, but no relation in point of time could be ascertained.

*Description.**

We can add but little to the original description given by von Graefe. He pointed out the fact that there are all gradations from the most malignant to the mildest. Most of the cases that have been published agree almost perfectly with the clinical pictures that he has described. The only facts which we deem sufficiently important to add are the following.

Malignant glaucoma may follow not only simple glaucoma but also subacute glaucoma† (Reuss, Reuling, Adamuek, and Schweigger), hemorrhagic glaucoma (Hirschberg), and even "intense glaucomatous inflammation." (?) ‡

* In the list of cases which we have collected above there are few that are described accurately; concerning many there are but brief notes. For the reason assigned at the beginning of the paper, all the material that it was possible to find was taken for use in the following study of the subject.

† While at Prof. Hirschberg's clinic the writer saw a case, as yet unpublished of this kind (December, 1887). The patient was a man aged about fifty, who had been under treatment for many years. There were occasional subacute attacks of glaucoma of greater or less severity. The field of vision remained unchanged until a short time before the operation, when an attack occurred which did not yield thoroughly to eserin. An iridectomy was made and the eye remained as hard after the operation as before. The anterior chamber was not re-established and the inflammatory symptoms increased in intensity. Weber's operation was performed during the third week. Sight was lost.

‡ Schweigger is authority for this statement, though none of the cases which he has reported or which have been reported by others warrant it. In one of von Graefe's cases iridectomy had been made for secondary glaucoma with clear media following dislocation of the lens.

Malignant glaucoma in most of the cases reported has followed iridectomy, but it may also follow sclerotomy, as is shown by Jacobson's and Schweigger's cases and confirmed by Knapp's experience. It is important to remember that malignant glaucoma has followed an iridectomy even though a previous puncture of the cornea with loss of aqueous humor gave no untoward result (Hirschberg and Schweigger), and that there is one case on record (Weber's) in which the first iridectomy did not produce malignant glaucoma while the second did.

The anterior chamber may become re-established (Hirschberg) and even persist for several days (Samelsohn), to disappear again with symptoms typical of malignant glaucoma.

Malignant glaucoma may occur in an eye previously operated upon, as the result of an iridectomy and the outbreak of malignant glaucoma in its fellow eye. V. Graefe's case (1) belongs to this class and is not a case of sympathetic ophthalmia.

To what Graefe has said concerning the course of the affection we may add that the wound may be forced open repeatedly (Adamuek), the ciliary processes may thus become prolapsed (Knapp), or the lens protrude through the wound (Reuling, Pagenstecher), or even escape (McHardy).

Recurrences of acute glaucoma may also take place (Knapp, Hirschberg, Schweigger).

Vision is not in all cases completely destroyed. Hirschberg and Schweigger have both reported cases in which moderate vision was retained for a long time.

Concerning the frequency of malignant glaucoma we may quote the following: von Graefe observed this condition in almost two per cent. of his cases of simple glaucoma upon which an iridectomy was made; Hirschberg had five cases in two hundred and eight operations for simple glaucoma; Knapp, four cases in two hundred and twenty-six; but Adamuek had but two cases in many hundreds of operations.

Etiology.—The greater predisposition of females to malignant glaucoma was first pointed out by Schweigger. Arlt and others have confirmed this observation. Among

the cases enumerated above the sex is mentioned in twenty-four; of these, eighteen are females. Most of the patients were adults, as would be expected when we consider the nature of the primary disease. Nagel observed malignant glaucoma in a boy aged ten, following an iridectomy for traumatic glaucoma, the only case of the kind in literature. Hirschberg and Schweigger saw the results of malignant glaucoma in a girl aged seventeen, and Laqueur observed it in a youthful individual. Two of the patients whose ages are stated were sixty-two and seventy-two respectively; both of these were males. All the rest were between thirty and fifty, and these were all females. This reminds us of the statement made by Schweigger, that the disease is most common among females during the climacteric period. Hirschberg laid stress in one of his cases upon the important relations between the onset of menstruation and the outbreak of malignant glaucoma in both eyes. In my own case no such relation existed. Angina pectoris has been considered a factor in one case (Reuling), and leaving the bed too early after the operation has been assigned as a cause (Adamuek). A fact of the utmost importance, originally suggested by one of Graefe's cases but emphatically pointed out by Schweigger, is the bilateral character of the disease. In at least sixteen of the cases which have been described both eyes were thus lost. In a number of these cases the iridectomy was done on both eyes at the same sitting. In others a short time or even a number of years elapsed between the two operations.

The statement of von Graefe still holds good,—that we know "no cause for the malignant attack either in mode of operation or in individual conditions of patients."

Pathology.—Our knowledge of the pathology of malignant glaucoma is exceedingly restricted. For this reason the few facts which are known must be pointed out. Weber and Pagenstecher have each examined an eye in the condition of malignant glaucoma pathologically. The former found the lens dislocated into the depression between the iris and the ciliary body. The latter likewise found the lens displaced, protruding through the wound and carrying the ciliary

processes partly along with it. Both of these writers consider the dislocation of the lens as the primary source of irritation and thus the cause of the malignant attack. It is still however an open question whether the dislocation of the lens forward is the cause or the result of an increased pressure behind it, in the vitreous humor.

Jacobson insisted that punctures of the vitreous show that the consistency of the vitreous is greatly increased in malignant glaucoma. This fact has been confirmed by Fuchs. The observation is one of greatest importance, for it not only suffices to explain the dislocation of the lens, the opening of the wound, etc., but also the fact that such eyes have been found by numerous observers to be unusually hard immediately after the incision has been made and the aqueous humor evacuated.

In Nagel's case a large fresh clot of blood was found within the eyeball. But this case differs so much from the variety commonly described that we are inclined to regard it as accidental. In our own case, moreover, we were soon able to examine the retina and could not find the slightest evidence of hemorrhage. The appearance of detachment of the retina in von Graefe's cases was probably due to secondary changes in the vitreous. Weber found a diffuse infiltration of leucocytes between the sclera and the choroid. The description is very vague and its significance cannot be ascertained.

Causation.—Several views have been expressed concerning the causation and true nature of malignant glaucoma.

Von Graefe in his original description considered it an acute glaucoma differing from primary acute glaucoma only in appearance, by reason of the absence of the anterior chamber. He believed it to be due to irritation of the ciliary body because he found the ciliary region near the wound very sensitive to pressure. Inasmuch as the ciliary sensitiveness is not present in all cases and usually makes its appearance only after a few days, while the increase of pressure is noted immediately after the operation, this appears more likely to be due to the pressure of the lens upon it than itself the primary source of the affection. On

the other hand, it is not improbable that, though being the result of an increased pressure in the vitreous, it may secondarily become a factor in still further increasing the intraocular tension. This is similar to Pagenstecher's view that the ciliary body becomes irritated by the pressure of the lens, which likewise closes the point of drainage made by the iridectomy.

Weber's explanation is based upon a purely mechanical consideration, the forward dislocation of the lens into the groove between the iris and the ciliary body; this impedes the circulation of the fluids in the eye and leads to an increase of tension. That the lens is not always thus displaced was shown by Pagenstecher's observations. Such dislocations as were found in both Weber's and Pagenstecher's cases may more readily be explained as the result of increased pressure from behind than as the cause of increased intraocular pressure. Schweigger and others have frequently observed long-continued absence of the anterior chamber,—in other words, anterior displacement of the lens,—after the iridectomy, without any rise of tension or diminution of vision. Nor is the fact that permanent relief has followed Weber's operation a proof that his theory is true; the escape of a little vitreous through a scleral incision has likewise ended a malignant attack. Weber's hypothesis is furthermore disproved by cases like my own, in which the condition was cured without operative measures; it is almost inconceivable that spontaneous reduction of a dislocation such as Weber describes could take place. Weber's explanation does not account for the fact that malignant glaucoma in most cases has followed the iridectomy for simple glaucoma.

Concerning Nagel's hypothesis, basing the increased pressure upon intraocular hemorrhage, we refer to what was said above, and need add nothing here.

The last theory that we must consider is that of Jacobson. He assumes that in the moment when the intraocular tension is relieved by the corneal incision, exudations from the over-filled veins are poured out into the vitreous; this causes pressure upon the coats of the eye, forcing the lens forward,

and thus produces increased congestion and continued exudation into the vitreous. This process would cause a change in the character of the vitreous, and this occurrence both he and Fuchs have pointed out. (See above.) This view explains the position of the lens and iris as the result of the increased pressure from behind. Jacobson assumes that the blood in the choroidal veins is forced back into the iris; if transudation can occur through the edges of the coloboma into the anterior chamber and pass out through the anterior lymph spaces the congestion may be relieved. All of the views that have thus been expressed are unsatisfactory; the last mentioned being the least.

It is safe to say that, definite though as yet unknown anatomical peculiarities * are the basis for the production of malignant glaucoma. The facts which render this probable are first and most forcibly the bilateral character of the disease; secondly, the much greater predisposition of females, and thirdly, the great preponderance of cases of simple glaucoma as the primary affection. These anatomical peculiarities are, it is probable, to be found in the posterior lymph channels of the eyeball. This is an assumption based upon the following facts: first, the high tension of these eyes before the operation; secondly, the deep excavations of the papilla without any marked congestion of the vessels in the anterior segment of the eyeball; and thirdly, the very important observation in our own case of the result of the instillation of atropia at a comparatively short time before the signs of simple glaucoma were developed. *Though the pupil was widely dilated for a number of days, the tension did not rise in the slightest degree; this proves that there was certainly at that time not the slightest impediment in the anterior lymph channels.*

Disturbances in the circulation leading to congestion of the uveal tract are likewise probable factors in producing malignant glaucoma. We assume this on the following grounds: first, the outbreak of malignant glaucoma in an eye operated upon some time before as a consequence of a malignant attack upon its fellow eye; secondly, the simul-

* Schweigger also assumes structural anomalies.

taneous appearance of malignant glaucoma in both eyes (though the second operation was done after an interval of eight days), the double affection occurring in connection and apparently as the result of the onset of menstruation,—a condition which in the case observed was always associated with violent circulatory disturbances of the head.

Diagnosis.—It is as yet impossible to foretell the outbreak of malignant glaucoma. Many observers lay stress upon very high tension as a diagnostic sign. We have seen that cases are on record in which the tension is not very high. Further observation is needed to confirm the observations of Jacobson. Until such time when cases of malignant glaucoma can be recognized before the operation, we must follow the very important rule insisted upon by Schweigger, to *operate on the worse eye first*, even though it be blind, and to be guided in our further steps by the manner in which this eye reacts on the operation. Unfortunately we cannot then operate on the fellow eye "without the least apprehension" (Schweigger). Even this rule will not always save us. We need only recall Graefe's, Weber's, and Hirschberg's cases.

Favorable reaction on paracentesis is no indication that malignant glaucoma will not follow an iridectomy.

Prognosis and Treatment.—The result in almost all cases of malignant glaucoma has been the absolute destruction of sight. In some cases light perception persisted for some time, in one case a little vision was permanently preserved without special treatment.

The results of treatment have been slightly more gratifying. Posterior sclerotomy, permitting escape of some vitreous, has given relief from pain and inflammation in a few cases, and it secured $\frac{6}{24}$ vision in Fuchs's case. Weber's operation preserved $\frac{15}{60}$ in Hirschberg's case (being more than before the operation).

Berlin and Hirschberg have extracted the lens, thus relieving the pain and inflammation. Rheindorf recommends this procedure, adding puncture of the cup-shaped depression of the vitreous. No cases are on record in which this was followed by improvement or retention of vision.

The suggestion of McHardy, to make a large incision with

the Graefe knife as in the extraction of cataract, should be considered. McHardy's results are not sufficiently definite to enable us to form a conclusion.

Kollock produced absolute relief of the malignant attack by means of the frequent instillation of a strong solution of eserin. In my own case eserin was used plentifully with absolutely no effect, for the iris was wedged so firmly between the lens and the cornea that neither mydriatics nor myotics could affect it. Fuchs's experience was similar to mine. In this case the results after repeated large doses of salicylate of soda * were so marked as to leave no doubt to the observers that the relief was the direct result of action of the salicylate. That this remedy produced a violent change in the circulatory system is shown by the profound depression that followed its use. We are therefore led to assume that it was the changes produced in the circulation of the eye that reduced the tension and restored the equilibrium of pressure. If therefore we recommend the trial of this remedy in cases of malignant glaucoma, we feel that we are not unjustified, even though the experience is based upon a single case.

It is necessary to avoid an iridectomy in the second eye when the first has been lost by malignant glaucoma. The treatment is limited in such cases to the use of myotics (Schweigger's rule).

It is well to bear in mind von Graefe's rule not to use a pressure bandage after the operation if the eye is found to be harder than normal.

In conclusion, it is important to draw attention to the fact that, in certain cases in which the malignant attack was aborted, the vision was *permanently improved.* In Hirschberg's case vision was better seven years after the operation than before, and in my own, central vision and the field of vision were both as good, a year after the operation as at the time of the operation. The progress of the primary disease, simple glaucoma, was checked!

* Sutphen (*Trans. Amer. Ophthal. Society*, 1895, p. 408) describes several cases in which salicylate of soda was used for glaucoma. The acute symptoms were relieved promptly, and the eye saved from enucleation. In most of the cases vision was irreparably lost before treatment was begun. In one case, subacute attacks were entirely relieved by the salicylate.

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GONORRHŒAL IRITIS AND NON-SUPPURATIVE GONORRHŒAL CONJUNCTIVITIS, AND THEIR PATHOLOGY.

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MANY of our authors, Stellwag,[1] Williams,[2] Carter,[3] Juler,[4] do not seem to recognize gonorrhœa as a cause of iritis. I have had three cases quite recently (one a relapsing case, the iris becoming involved at each invasion of the urethra), in the first of which there was quite a lively synovitis of all the large joints, but in the subsequent attacks the iris involvement came without the synovitis; a permanent posterior synechia may account partially for this, as some writers on the subject say a synovitis *must* precede the iritis. Nettleship,[5] page 444, says: "Rheumatic iritis occurring for the first time with gonorrhœal rheumatism is, in my experience, more often symmetrical than other forms of arthritic iritis or the later attacks of iritis in the same patient. Of 104 cases of iritis with well-marked rheumatic symptoms, *and 6 with gonorrhœa but no rheumatism*, in all of which syphilis was so far as possible excluded; (*a*) In 34 of this series the first attack of iritis came on during or very soon after gonorrhœal rheumatism; in exactly one half of these cases the iritis was double. In 6 others (making 40 in all) there were iritis and gonorrhœa but no rheumatism (gonorrhœal iritis), and here the proportions were the same. (*b*) In the remaining 70 cases the first iritis had no relation to gonorrhœa, and in the sub-series the attack was single in 56 and double in, at the most, 13 (2 or

3 being doubtful), or about $\frac{1}{8}$. No corresponding difference obtained in regard to the relapses, the vast majority of the recurrent attacks in both sub-groups affecting only one eye at the time. Some cases of gonorrhœal iritis have been described in which there is iritis due to gonorrhœa without arthritis being actually present. Probably in these cases the iritis is the first indication of gonorrhœal rheumatism; a variety of quiet conjunctivitis not due to infection has also been described, without pain, and hardly any discharge. (Despagnet and others)."

It will be observed from this that Mr. Nettleship recognizes gonorrhœa as a cause of iritis; that it can be and is present in small numbers of cases without arthritis; also that we have a non-suppurative form of gonorrhœal conjunctivitis, a case of which I will report later.

Max Knies,[6] page 312, says: "Gonorrhœa may also be the cause of *metastatic* diseases of the eye, especially of different forms of iritis. These exhibit marked clinical similarity with so-called rheumatic iritis in articular rheumatism; they are often associated with spontaneous coagulation of the fluid in the chamber (so-called lens-shaped or gelatinous exudation, spongy iritis) but exhibit no other peculiarities. This form of iritis, which is observed almost exclusively in men, is usually bilateral, and often returns with relapses of the gonorrhœa, or alternates with inflammation of the joints. As a rule, the iritis is associated with inflammation of the joints, especially of the knee and ankle, and the clinical similarity to rheumatic iritis is thus increased. Förster (*l. c.*, page 86) mentions a number of cases in which the inflammation of the joints and the iritis relapsed, but not the gonorrhœa."

It has been my experience to have had more cases of iritis in chronic rheumatism, than in acute attacks.

Noyes,[7] page 410, says: "Gonorrhœa occasionally causes iritis. The arthritis of gonorrhœa is due to the presence of gonococci in the joints, and the same explanation is probable for iritis."

Roosa,[8] page 313, says: "Gonorrhœal iritis occurs occasionally in the course of urethritis, especially of that which

has associated with it inflammation of the joints. It is rather a rare disease."

DeWecker,[9] page 176, under the head of blennorrhagic iritis, says: "It is peculiar in that it is made up of both serous and plastic iritis. It is correlated beyond all doubt with the rheumatic form, for we never see an inflammation of the urethra followed by iritis without some joint having been attacked previously. If I distinguish it from rheumatic iritis it is because it does not present the true anatomical character of the latter, and because it is a hybrid form, being easily cured and leaving no traces, while reappearing very readily, whenever the patient has the least tendency to urethritis."

DeWecker says: "We must have the joint involvement precede the iritis." In this I am sure he is mistaken; also equally sure that he is in error when he says the disease gets well with no damage to the organ. In a sero-plastic inflammation of the iris there must be some involvement of the ciliary body. In a case I have on hand now which was recognized and treated early in the disease, there is synechia posterior which will not give way. I think the disease runs a shorter course and is more easily managed than iritis from other causes, but there is often much permanent damage resulting.

Swanzy,[10] page 224: "Gonorrhœal iritis is a mixture of the plastic and the serous forms. It does not attend on nor immediately follow a gonorrhœa, but an attack of rheumatic arthritis, usually of the knees, *always* intervenes. Gonorrhœal iritis is extremely rare."

Schweigger,[11] page 342: "Iritis also occurs in connection with articular rheumatism, especially those forms which appear to stand in connection with gonorrhœa."

Juler [4] does not refer to it in the recent edition of his text-book, 1893.

Berry,[12] page 132: "Closely allied to rheumatic iritis is the rare form which undoubtedly is associated with gonorrhœa. The inflammation is always severe, and the cause, *owing to co-existing inflammatory changes in the joints*, apt to be overlooked. Gonorrhœal iritis always seems to occur in

both eyes, though not always quite simultaneously, and with it may be different degrees of severity in the two eyes. Successive attacks of gonorrhœa are sometimes accompanied each time by iritis, and in other cases, although no fresh inoculation takes place, a return of the joint affection may be accompanied by a recurrence of the iritis as well."

Norris and Oliver,[18] page 358: "Notwithstanding the prevalence of gonorrhœa and the assertion of Förster that if the urethra be habitually inspected in every case of iritis, the two diseases would be found more frequently coinciding, yet iritis due to gonorrhœa clinically seems to be of comparatively rare occurrence. It does not generally occur as an immediate consequence of gonorrhœa, but develops in those cases where there are swelling of the joints and rheumatism. In such cases renewed attacks of gonorrhœa are frequently accompanied by fresh exacerbation of iritis."

"Förster asserts that, even where there has been no new infection, there may be a fresh attack of iritis whenever from any cause there is a recurrence of a thin gleety discharge from the urethra."

CASE 1.—The patient was a woman. She had just returned from her bridal tour when she came to see me concerning an inflammation of her eyes. I found she had double iritis; on looking for the cause she spoke, after some questioning, of having a severe attack of the "whites," attended by great pain on urinating; she said during her trip her modesty prevented her attending to the calls of nature as regularly as she should have done, and attributed the symptoms to that. She had some pain in her limbs with some swelling of the joints. I put her on the usual local treatment, and gave her internally oil of gaultheria and potassium iodide; recovery was quite prompt. I afterwards learned that her husband had gonorrhœa at the time of his marriage; that he had delayed the wedding on this account as long as possible.

CASE 2 is in a gentleman. Both eyes are involved, the left much worse than the right. This case has been much more obstinate; it was of the sero-plastic form. It is undoubtedly a case of gonorrhœal iritis. This case was a very violent one in which leeches had to be used. It has been on hand now six or eight weeks.

CASE 3 was in the person of a young married woman. I found her suffering but little pain, except when exposing the eye to light. She had the room darkened, and had been using cold cloths locally. She had gonorrhœa acquired from her husband, who thought himself well. She had three relapses, each preceded by an exacerbation of her gonorrhœa and an arthritis. Atropia would not at first dilate her pupil: cocaine muriate and hot fomentations followed by atropia finally gave her a round pupil; this case was sero-plastic in form. As soon as her pupil was dilated, and oil of gaultheria given a few days, her recovery was quite rapid. The relapses were several weeks apart. Each relapse was, as I stated before, preceded by an exacerbation of her gonorrhœa and an arthritis; each relapse was less severe than the preceding one. The patient finally made a good recovery.

I have recently had under my care for the third time a gentleman with *conjunctivitis;* both the ocular and palpebral conjunctivæ are involved; vision is perfect; there is considerable burning and pain, with little or no secretion; some photophobia; no rheumatism; no involvement of any of the other tissues of the eyes. He has had two previous attacks of gonorrhœa, with each of which he had similar attacks of conjunctivitis. I gave him an eye-bath of saturated solution of boric acid, to be used hot every two hours, with salicylates internally. Recovery was very rapid. There was some tendency to relapses when there was from any cause an exacerbation of the urethritis. The peculiarities of this case of conjunctivitis was the severe burning and pain, the diffuse character of the congestion, with the small amount of secretion.

Dr. Knapp calls my attention to a most excellent paper on this subject by G. Haltenhoff, page 169, vol. xv., ARCHIVES OF OPHTHALMOLOGY. Dr. Haltenhoff reports a series of cases of his own and many by other authors, among them, Hirschberg, who mentions a case of benign or abortive form of gonorrhœic ophthalmia. Other cases of abortive gonorrhœic ophthalmia have been reported, so says Haltenhoff in the article referred to above, by Grima, Gepner, Tarizot, Hecker, Lippert, and Haab. Haltenhoff calls our attention to the fact that, "the internal clinicists, more especially venereologists, have remained, up to this day, believers in a non-inoculated gonorrhœic conjunctivitis in opposition to ophthalmologists." Haltenhoff also gives us

cases from Cullerier, Mauriac, and Icard, the latter calling it ophthalmie purulente arthritique. "Alf. Fournier, though," Haltenhoff says, "gives us the most explicit and minute information on this subject. He considers the subject under two heads, ophthalmie de contagion and ophthalmie rheumatismale,—the latter of which he divides into serous iritis, iritis simplex, and conjunctivitis, generally accompanied by slight irritative symptoms, scanty catarrhal secretion, limited at times to the caruncle and palpebral conjunctiva."

This form of conjunctivitis may be present occasionally without joint involvement, and the latter may precede or follow the eye trouble. Haltenhoff says: "Prof. White of Philadelphia likewise distinguishes as absolutely distinct inoculated gonorrhœal ophthalmia from the benign form of double conjunctivitis generally accompanied by gonorrhœal rheumatism, besides the more common sclerotitis, and iritis. White says whilst in seven to eight hundred cases of gonorrhœa there occurs only one case of ophthalmo-blennorrhœa, he counts one case of rheumatic ophthalmia in fifty or sixty cases of gonorrhœa, a relative frequency, therefore, of 13 or 14 to 1."

With these facts before us can any one doubt the existence of a non-inoculable conjunctivitis depending upon gonorrhœa? We see but few cases, comparatively, because with our cases of conjunctivitis we seldom look so far for a cause, and because the disease yields so readily to treatment and needs no special medication. The disease seems to be very rare in women, all the cases reported being in men.

As to pathology, Haltenhoff, in this same article I have quoted from so much, says: "To modern pathologists those theories appear to be the most acceptable which suppose an absorption of certain products from the diseased urethral mucous membrane into the blood,—products endowed with phlogogenic influence upon a certain class of tissues. Benign gonorrhœal conjunctivitis might thus naturally be classed with well-known exanthematous forms of conjunctivitis." The older writers, as mentioned in this article of Haltenhoff, seem to have given considerable attention to this form of

conjunctivitis, while the more modern ones, or such as I have been able to consult, with the exception of Nettleship, in his edition of 1890, on *Diseases of the Eye*, page 444, where he gives a line or two to the subject, say nothing whatever about it.

A recent paper in the April number, *Bulletin of the Johns Hopkins Hospital*, by Drs. Thayer and Blumer of the Johns Hopkins Hospital staff, on "Ulcerative Endocarditis due to the Gonococcus and Gonorrhœal Septicæmia," has in it much of interest bearing on this subject. Drs. Thayer and Blumer say: "In the majority of cases in literature when the direct association of endo- or pericarditis with gonorrhœa has been made out clinically, an arthritis has also existed." Morel ("Des Complications Cardiaques de la Blennorrhagie," *Thèse for 1878*, No. 269), however, in his conclusions asserts that "rheumatism is not a necessary intermediary, though the co-existence of these two lesions is the usual condition. A particularly interesting case of this nature, endo- and pericarditis appearing on the fifteenth day after the beginning of the urethral discharge without co-existing arthritis, has recently been reported by Prevost (*Arch. Méd. Belges*, 1895). Wertheim (*l. c.*) showed clearly that in the female direct infection (per continuum) of the uterus, tube, ovary, and peritoneum may occur."

"The power of the gonococcus to cause suppuration is now undoubted. The ophthalmia is also clearly an infection by direct transmission of the virus; but if entrance of the gonococci into the tubes and ovaries can be traced per continuum, and into the eyes by direct transmission, the same cannot be said of the iritis, which has been observed without a coincident conjunctivitis, nor of the commonly observed arthritis, nor of the various processes which have been observed in the nervous system. Indeed there are relatively few of the numerous complications of gonorrhœa, such as conjunctivitis, cystitis, metritis, salpingitis, epididymitis, arthritis, periarthritis, peritonitis, pleurisy, local foci of suppuration, myocarditis, indeed general pyæmia, various cutaneous affections, iritis, neuritis, meningitis, meningomyelitis, albuminuria, etc., which we can clearly trace to an

extension per continuum or, however much we may suspect it, to a direct transmission of the infective agent. Even in epididymitis, where until recently the extension per continuum has been generally accepted, the entire freedom from disease of the tracts connecting the urethra and epididymis has compelled us to seek another explanation."

"Are these secondary processes purely gonorrhœal? If so, what is their relation to the primary lesion? As Finger (*Arch. für Dermat. und Syph.*, Wien und Leipzig, 1894, xxviii.) well says: 'There are various possibilities in this connection: (*a*) The complication is produced by the gonococcus alone—purely gonorrhœal. (*b*) The disease of the mucosa furnishes the opening through which the pyogenic cocci enter and give rise to the complication—mixed infection. (*c*) The gonococcus produces the complication, into which, however, the pus-cocci enter later; both exist together until the gonococcus, dying, is succeeded by the pyogenic coccus—secondary infection. (*d*) The complication is essentially not of a microbic nature; it is produced by the products of the growth of the gonococcus in the urethra, and absorbed—toxic nature.' Finger then says: 'By entrance into the blood current, distributed by this, the gonococcus may be the cause of the most varied articular, periarticular, and perichondric metastases, and entering into the connective tissue the gonococci may succeed in causing a genuine suppuration.'

"The proof, however, that many of the secondary suppurative processes are genuine gonorrhœal metastases is not enough to justify the assumption that all are of the same nature. The fever and constitutional symptoms, the albuminuria so commonly present, all point to a general intoxication, while the unsuccessful efforts to demonstrate bacteria in the lesions of the nervous system suggest strongly that these changes may be due to a soluble toxine. We must probably recognize in genorrhœa a general disease, one which from a local starting-point may cause severe general symptoms, fever, chills, albuminuria, while in other instances grave secondary lesions may follow. In some instances including conjunctivitis, epididymitis, metritis, etc., local

suppurative processes, it has been definitely shown that the gonococcus itself may be the exciting cause, the coccus reaching the affected areas doubtless through the blood current; in other instances, including neuritis, myelitis, cutaneous manifestations, iritis, the negative results of microscopical and cultural researches suggest that the local lesion may be due to a toxine alone."

From these articles then of Drs. William Sydney Thayer, Geo. Blumer, and Haltenhoff, I think we can say that the so-called gonorrhœal iritis is more probably toxic, than the result of the gonococcus in the blood; the iritis always being non-suppurative appears to me another argument of the toxic origin of the disease; that a certain form of non-suppurative conjunctivitis occasionally associated with gonorrhœal urethritis is the result of toxines also. In these few pages it has been my endeavor to report a few cases of gonorrheal iritis mainly to give its more recent pathology, and to call the attention of the profession to a form of conjunctivitis the etiology of which is not often recognized, modern authors paying it little or no attention; claiming for it (which is not new) its dependence, as does that of gonorrhœal iritis, upon toxines.

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TRAUMATIC EXPULSION OF BOTH LENSES.

By A. J. ABBE, A.M., M.D., Fall River, Mass.

THE following case is reported on account of the double coincidence of a similar accident occurring to both eyes, and of a fair result in both instances.

On March 7, 1894, R. P. W., a man seventy-five years of age, while stooping down to look into the ash-pit of his steam heater, brought his right eye against the blunt-pointed end of the lever which works the shaker. Immediate blindness resulted. There was not much pain for two days, then it became intense. His family physician, Dr. Dwelly, applied hot fomentations, used boric-acid lotion, and morphine p. r. n. I saw him on the thirteenth day, and found him in bed with severe pain in the eye and head. Above the cornea was a rupture of the sclera, through which protruded a hernia of the choroid the size of a pea and about 5 *mm* high. Anterior chamber apparently filled with blood. Marked cyclitis. Tension diminished, and the whole ball very sensitive. V = o. The prognosis seemed bad. He told me that he had lost the other eye twenty years before. I examined this only enough to find that he could not count fingers at 1 metre, but he had perception of light. Accordingly, the best treatment seemed to be an expectant one. Atropine, heat, and large doses of morphine were used. Gradually the inflammation subsided, but the red reflex by reflected light still persisted. This was the size of the cornea. At the end of a month the eye was comfortable. Vision had not changed perceptibly.

My next examination was just four months after the injury, when the *status præsens* was as follows: O. D. Arcus senilis; pterygium involving one half the radius of cornea. In the centre of the upper temporal quadrant of the sclera, beginning at the limbus and running upward and outward, was a rupture of sclera, with a

hernia of the choroid, in size 6×4 *mm*, and projecting from 1 to 3 *mm* from the surface. Complete aniridia. Aphakia. Vitreous fluid, with many small floating opacities. The disc surrounded by an irregular shaped patch of choroidal atrophy of about three disc-diameters in area, and most extensive toward the macula, V O. D. = $\frac{1}{60}$, increased to $\frac{6}{60}$ with s + 12.00; with + 16.00. reads Jäg. No. 6.

O. S. was hit with a piece of wood twenty-two years ago. Patient was in bed six weeks, and after two more weeks was seen by the late Dr. H. W. Williams, of Boston, who gave no treatment. *Stat. præs.:* Arcus; pterygium. At the upper nasal quadrant of sclera there is a rupture 2 *mm* from limbus, running upward 4 *mm*, and 2 *mm* wide, projecting $\frac{1}{2}$ *mm*. Iris prolapsed and tremulous; pupil displaced upward; aphakia. V O. S. = $\frac{1}{60}$, increased to $\frac{6}{24}$ with s + 12.00. Reads J. No. 4 with + 16.00. With these lenses he goes about comfortably and reads his newspaper by the aid of a hand-glass. Up to this date there is no irritation in either eye.

RESTORATION OF VISION TO AN EYE THAT HAD BEEN PRACTICALLY BLIND FOR SEVENTEEN YEARS.

By DAVID WEBSTER, M.D., New York.

June 29, 1892. Col. J. H. H., æt. fifty, married, was brought to my office by my friend, Dr. John S. Kirkendall, of Ithaca, for consultation in regard to his eyes. He gave the following history: Fourteen years ago one dark night he reached up to a closet shelf for a goblet and knocked another down. It broke and a piece of the glass flew and struck his *left* eye. It cut through the upper lid and wounded the globe at the sclero-corneal margin. He was treated at an institution in Elmira where the eye was bandaged and he was kept in a dark room for eleven weeks. He grew gray in those eleven weeks. The iris is drawn up to a cystoid cicatrix at the seat of the original injury, with a peripheral pupil about the size of the head of a pin. The vision of this eye is $\frac{1}{200}$ and not improved by glasses. Its projection is normal.

Incipient cataract was first discovered in the *right* eye a year ago, although he has seen "floating specks" for five or six years. The vision of the right eye is $\frac{8}{10}$. Ophthalmoscopic examination of the right eye shows opacities of the crystalline lens and floating bodies in the vitreous. The fundus cannot be satisfactorily examined. The visual field is good, and the tension normal in both eyes.

I advised an iridectomy downward upon the *left* eye. The operation was indefinitely postponed, however, for reasons over which the patient had no control.

I next saw the patient on November 21, 1895. He was then suffering from an attack of purulent ophthalmia of the right eye, which was said to have been caused by getting some foreign sub-

stance into it, and for which he had been under treatment, during several weeks, by a distinguished ophthalmologist. The lids were red, swollen, stiff, harsh, and corrugated. The chemosis had subsided and the secretion had mostly ceased, but the eyeball was red and irritable and the cornea was the seat of a large perforating ulcer. All the portions of the cornea not ulcerated were so infiltrated that the iris could be discerned with difficulty, and seemed to be adherent to the posterior surface of the cornea. The tension of the eyeball was diminished, and its general appearance suggestive of commencing *phthisis bulbi.* There was perception of light but the projection was very imperfect. Dr. Kirkendall and Dr. G. R. Trowbridge, who saw him in consultation, agreed with me that we should try to save the eyeball. There seemed to be little to be done in the way of local treatment besides bathing the eye frequently with hot water and keeping the lids greased with vaseline in the intervals. Meanwhile, the indications were that we should try to restore vision to the other eye which had been practically blind for seventeen years and on which all his hopes were now centred. Accordingly, on January 4, 1896, assisted by Dr. Kirkendall, Dr. Trowbridge, and Dr. T. B. Johnson, of Towanda, Pa., I performed an iridectomy downward, under chloroform. A large coloboma was made extending all the way across the eye from above downward, the broadest portion being at the lower periphery of the iris. The coloboma became filled with blood immediately upon cutting the iris so that it was impossible to see whether a cataract was present or not. The eye recovered kindly and as soon as the blood was sufficiently absorbed a cataract could be plainly seen. The opaque crystalline lens appeared to be somewhat shrunken so that the patient had some useful vision through its peripheral portions. When the eye had entirely recovered from the iridectomy he could count fingers at two feet and could distinguish the faces of his friends. Of course it remained to extract the cataract, but it was not considered quite safe to do this while the right eye remained inflamed and irritable. The latter was subject to relapses, or exacerbations of inflammation. It would remain quiet for a few days and then would suddenly become swollen, painful, and irritable, running water and causing the patient great discomfort. Dr. H. Knapp saw the patient with Dr. Trowbridge and myself and, after a most careful and painstaking examination, counselled enucleation. On January 23, 1896, I enucleated the eye, Dr. Trowbridge and Dr. S. M.

Payne assisting. The patient took chloroform badly. The eyeball was placed in Müller's fluid, and some weeks later was examined by Dr. Ward A. Holden, who reported as follows: "The eyeball shows a very marked episcleral infiltration of round cells about the sclero-corneal junction, extending up into the cornea beneath the epithelium. In the cornea is a large scar covered with irregular epithelium, indicating the existence of, previously, a broad ulcer with sloping margins that had led to a small perforation of the posterior layers of the cornea, into which the iris fell, healing into the scar. On the surface of the iris, in some parts, there is a fibrinous exudation; in others, a membrane of new connective tissue. There is hardening of the nucleus of the lens. The other ocular structures are normal, except for the remains of some slight hemorrhages in the retina."

April 9, 1896.—The patient wears an artificial eye. The vision of the left eye is $\frac{1}{200}$ and the projection normal.

May 2d.—Assisted by Drs. Payne, Kirkendall, and Trowbridge, I extracted the cataract under cocaine anæsthesia. The instruments were rendered aseptic by immersion in boiling water. The eye was washed with a solution of bichloride of mercury, 1 to 5000. An incision was made with a von Graefe's knife through the lower margin of the cornea, the puncture and counter-puncture being in the limbus, while the central portion of the wound was about a line and a half in the clear cornea. I incised the capsule of the lens along both edges of the coloboma and across the lower part a little above the wound. I then tried to extrude the lens by pressure with spoons. It presented at the wound, and while making pressure behind it with the tortoise-shell spoon I endeavored to coax it out with sharp hook and with cystitome. But the pillars of the coloboma were stiff and unyielding, and as the lens did not come out easily and quickly, the patient grew restless and lost control of his eye and turned it suddenly upwards. As he did this, the pressure of the spoon being removed, the lens began to slide upwards away from the wound, leaving the lower half of the pupil clear. Appreciating the danger of escape of the lens into the depths of the vitreous, I quickly introduced a wire spoon behind it, caught it, and by gentle traction succeeded in getting it out of the eye with a minimum amount of violence. A few drops of vitreous followed the exit of the cataract. The latter was shrunken to about three fourths the normal size, tough, and of a very dark-yellowish color. The eye was dressed with

bichloride vaseline, 1:5000, bichloride gauze, absorbent cotton, flannel bandage, and a Ring's mask.

May 3d.—The patient, having some pain last night, took morph. sulph. gr. $\frac{1}{8}$, chloral hydrate, gr. x., potas. bromid. gr. xx., and slept, on and off, during the night. On waking he experienced brilliant photopsiæ several times, but the flashes of light would disappear after he had kept perfectly quiet for a while. There is no pain, but the eye feels sore, as if it had been struck.

May 6th.—The wound is closed, the anterior chamber is refilled, there is redness of the eyeball, but no chemosis. To the outer third of the wound is attached a small, slimy mass, probably of incarcerated vitreous.

May 10th.—As repeated attempts to wash away the above-mentioned slimy mass had failed, I now seized it with iris forceps, put it on the stretch and excised it with scissors close to the wound. As the continued redness of the eye seemed to indicate a mild form of iritis I now placed the patient upon mercurial inunction. Soon the eye began to be less red and the vision to improve, and on June 1st, about one month after the extraction, the patient was well enough to come to my office. He then had vision $\frac{20}{200}$ with + 5. D. s. ⊂ + 6. D. c. axis 15°. His vision steadily improved from this time on, and, on July 5th, when I fitted him with glasses, he had vision $\frac{20}{40}$, with + 8. D. s. ⊂ + 5.50 D. c. axis 10°; and with + 13. D. s. ⊂ + 5.50 D. c. axis 10°, he read Jaeger No. 1 at about eight inches.

I have seldom met with a case which gave me more anxiety than did this, or in which the final result was more gratifying. The patient held an important position in a railroad office, and loss of sight meant to him loss of salary and of the means of livelihood for his family as well as all the other miseries that blindness involves. I think the case is a rare one. So far as my memory serves me, my own experience does not include another case in which good vision has been restored to an eye that was practically blind from the result of injury for so long a time. The patient's susceptibility to local poisoning by mydriatics was a continual source of embarrassment in the treatment of his eyes.

REPORT OF A CASE OF EMBOLISM OF THE CENTRAL ARTERY OF THE RETINA, WITH INTEGRITY OF THE TEMPORAL RETINAL DISTRICT.

By Prof. LAQUEUR, Strasburg, Germany.

Translated and abridged by Adolph O. Pfingst, M.D., Louisville, Ky.

On February 13, 1895, a girl of twenty years presented herself to me complaining that the sight of her left eye had suddenly become defective three days ago, and had remained so. The patient was otherwise healthy and had been so since her childhood. Externally her eyes appeared normal. The functional examination of the right eye revealed normal conditions. The left eye had V = $\frac{6}{5}$, although she was able to read Jaeger No. 1 at 25 *cm* without difficulty. The V F was remarkably small. Above, it hardly extended beyond the line of fixation. On the nasal side it extended 3–4°; below, 6°; and on the temporal side, 12°. Colors were distinguished centrally. There was slight pupillary reaction when light was thrown into the pupil from the point of fixation. The ophthalmoscopic examination showed the media to be clear, but marked changes in the fundus were noticeable. With the exception of a small strip on the temporal side which appeared normal, the fundus presented a milky-white appearance around the disc. At about 3–4 times the width of the papilla from the disc the fundus rapidly, though not abruptly, resumed its normal appearance. With the exception of the temporal border, which represented about $\frac{1}{3}$ of the circumference, the outline of the disc was not recognizable. The blood-vessels in the opaque area were so narrow that the veins were not always to be distinguished from the arteries. Near the periphery of the white zone the veins plainly showed interruptions in their columns

of blood. The strip of normal fundus according to its position, apparently contained the macula lutea. The upper and lower boundaries of this area were formed by horizontal vessels running towards the periphery. They marked the edge of the opaque portion, and were in fact covered in parts by it. A little below the upper one and parallel with it, was a large vessel (in the normal retina) which subsequent investigations showed to be an artery. There were also several small arteries barely visible running towards the macula. As the conditions found were, with the exception of the normal area on the outside, characteristic of embolism, I asked Prof. Naunyn to make an examination of the general condition of the patient. He reported a mitral lesion, probably following recent endocarditis. A systolic bruit was to be heard and the second pulmonary sound was intensified. The area of dulness over the heart was normal. Urine normal.

Following up the case it was found that five days later the column of blood in the vein was continuous. The veins could be made to pulsate at the disc by slight pressure on the globe. Pupillary reaction to direct light was almost normal.

Feb. 21st.—The opacity was beginning to clear up on the nasal side of the disc. Central vision was normal.

March 4th.—The upper and lower borders of the disc were becoming visible. The narrowness of the vessels was now more plainly visible. The upper border of the normal area of fundus was less sharply defined. The pupil reacted to direct light, but not as well as when the light was thrown into the other eye. There was slight reaction also when light fell into the pupil from the right or the left side. The opacity had gradually diminished, but had not entirely disappeared by the end of March. The disc at that time was atrophic and the outlines plainly visible. The horizontal arteries on the temporal side were normal, the others very narrow. The inferior artery showed a conical constriction near the disc. The central vision was normal. Field unchanged. Treatment, which had consisted in faithfully applied massage, had no effect upon the course of the disease.

At the last examination, made eight months after the attack, the pupillary reaction and V F were unchanged. The ophthalmoscope showed white atrophy extending over the entire disc. The retina had entirely cleared. The region of the macula was discernible, being somewhat darker than the surroundings. The superior and inferior arteries were very narrow. The veins were

also narrow, the upper one alone being comparatively normal. The large artery, before mentioned, on the temporal side could be followed to the periphery of the field. Only one of the macular arteries (lower one) was recognizable as the minutest thread. The condition at that time no doubt represented the ultimate outcome of the affection.

This case represents one of embolism of the arteria centralis retinæ, not affecting the temporal trunk, which was given off just before the place where the embolus had lodged. It is evident that it was this large artery which furnished nourishment to the patch of normal retina, and the hypothesis of cilio retinal nourishment in this case seems out of the question. There was no sign of the cilio-retinal vessels, described by some authors as arising at the edge of the disc with a sharp contortion.

Our case is, on the whole, a repetition of a number of cases of embolism of the central artery not affecting the region of the macula, though it differs from them in some of its most important features. A short review of the cases previously published may prove instructive, especially as they are scattered about in the literature and are not at the disposal of many of us.

The first case reported was observed by L. Mauthner [1] in 1873, in a man of fifty-eight years. The patient who had formerly been subject to rheumatism suddenly observed a defect of his vision. Two weeks later he had an apoplectic stroke. When examined by Mauthner, four months later, the nerve was atrophic, the retinal vessels narrow, but the region of the macula was normal. Central vision normal. V F very much contracted. At this time Mauthner was of the opinion that the normal area of the retina derived its nourishment through anastomoses between the retinal and ciliary vessels. He afterwards abandoned this theory.

Leber speaks of a similar case in his essay on the "Diseases of the Retina" in *Graefe-Saemisch*, vol. v., 1873.

Saemisch reported three cases at the International Medical Congress at Amsterdam in 1879. In one of them, in which blindness had developed suddenly in one eye, he observed the changes in

[1] L. Mauthner, *Jahrb. der Gesellschaft Wiener Aerzte*, vol. ii.

the fundus characteristic of embolism, excepting that a triangular area, whose base was represented by the outer edge of the disc and apex by the macula, remained normal. The visual field, especially in the vertical direction, was highly contracted. Saemisch afterwards observed three more cases, the first of which was reported in 1874 by P. Schneller.[1] In a girl of twenty-five years, who had suddenly become blind in one eye, the retina of that eye was opaque all around the disc, leaving only a narrow strip of normal retina between the disc and macula. The other two cases were reported by Schneller and Hillemanns, and will find mention later.

Arthur H. Benson[2] reported the next case in 1882. The patient, a girl of sixteen years, suddenly lost the sight of one eye. Opacity about the disc excepting on the macular side. Between the disc and macula a sharply defined oval area of perfectly healthy retina remained. Benson described a so-called cilio-retinal vessel which began at the outer edge of the papilla, and traversed the healthy retina towards the macula. He attributed the preservation of the normal condition of the oval area to this vessel. The vision, which had been reduced to P. of L., gradually grew to $\frac{2}{3}$. The V F also grew larger, which was, according to Benson, brought about by the use of continuous galvanic current. This case presented a peculiarity in the fact that, after atrophy of the optic nerve had taken place, a large number of white spots appeared in the retina, and degenerative changes were visible at the macula.

Mention should be made of the fact that there were, besides the cilio-retinal vessels spoken of, normal branches of the central artery distributed to the region of the macula in this case.

In 1883 Birnbacher[3] added another case to the literature. The patient, a woman forty-three years old, had hypertrophy of the left ventricle of the heart, and the first sound was marked. She suddenly lost the sight of her right eye. The nerve was pale and was, with the exception of the outer side, as in the other cases, surrounded by milky retina. Two good-sized vessels, recognizable by their reflex as arteries, arose from the edge of the disc and took an outward course through the normal retina. Birnbacher took these to be cilio-retinal vessels. The patient, who could

[1] P. Schneller, *Zur Embolie d. art. cent. ret. ohne Betheiligung der Maculargefässe*, Rheinbach, 1880.
[2] Arthur H. Benson, *Ophth. Hosp. Reports*, vol. x.
[3] Birnbacher, *Centralblatt f. Augenheilkunde*, vii.

only count fingers at 2½ feet at the time, five months later had V = ½. The visual field, which at first was highly contracted, according to Birnbacher, returned to its normal size.

Hirschberg[1] reported a case of embolism, with cilio-retinal circulation on the temporal side, in 1885. It was in a man twenty years old, who had suddenly become blind in the left eye. As in the other cases described, the fundus showed a normal area (triangular) on the temporal side of the disc, the rest of the disc being surrounded by milky-white retina. The normal portion was traversed by a small artery which arose from the outer edge of the papilla. V = $\frac{15}{200}$. V F very much contracted corresponding to the area of normal retina. The vessel on the temporal side at first normal, later on became narrow, until finally it was a mere thread. Based upon this observation, Hirschberg looked upon this vessel as a branch of the central artery, which had grown narrower on account of the extension of the embolus, and not as a cilio-retinal vessel.

About the same time that Hirschberg published his case Knapp[2] reported two similar ones. Both were in men who had suddenly become blind in one eye. A normal artery, which arose near the edge of the disc and took a course towards the macula, could be made to pulsate on pressure. It was accompanied by two veins, corresponding in size to the artery. An ellipsoid of normal retina extended from the disc to the macula, otherwise the disc was surrounded by opaque retina. The macula contained the red spot characteristic of embolism. Figures could be counted at twenty feet. The V F was contracted corresponding to the normal area. One of these cases terminated in blindness, while the vision in the other returned to normal. In the latter the vessel running towards the macula remained normal, while the other vessels returned to about two thirds their normal size. In the eye which became blind the disc and all of the vessels, including the one on the temporal side, underwent atrophy. Knapp took a decided stand against the possibility of the existence of a cilio-retinal vessel. He attributed the loss of vision in the first case to extension of the embolism.

Leplat[3] also reported a case, in 1885, of a woman sixty-two

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[1] Hirschberg, *Centralb. f. Augenheilk.*, vol. ix.

[2] Knapp, *Sitzungsbericht d. ophthalm. Versammlung in Heidelberg*, 1885, p. 219.

[3] Leplat, *Annales d'Oculistique*, vol. xciv.

years old, where blindness came on suddenly on the left side. Fundus showed the usual changes. The quadrangular area of normal retina on the temporal side was hardly larger than the disc. A normal artery, which arose from the edge of the disc, however, without making the sharp contortion characteristic of the cilio-retinal vessel, passed into and was lost in the normal retina. Beyond this normal area the fundus was opaque as around the disc. V at the beginning = P. of L. V F narrow. A month later, after paracentesis of the anterior chamber and massage of the eye, V = $\frac{1}{15}$. V F was 20° wide and 15° high, but only extended 3° on nasal side. Although Leplat did not dispute the existence of cilio-retinal vessels, he thought that they played no part in his case. The normal vessel on the temporal side had not arisen by a sharp contortion, and he considered it a patent branch of the central artery.

P. Schneller (*l. c.*) published another one of Saemisch's cases in 1888. Female, twenty-seven years old, without a marked heart lesion, became suddenly blind in the right eye. When seen by Schneller, six days later, there was a milky opacity around the disc enclosing a triangular area of normal retina, whose apex was represented by the macula, on the temporal side. The macula contained the characteristic red spot, and between the disc and macula a small retinal hemorrhage had taken place. V = $\frac{20}{100}$, Concentric contraction of V F. Three weeks later the sharply defined area of normal fundus was still plainly discernible. Four or five small vessels traversed it from the disc. V and V F were unchanged. Two months later the milky opacity had entirely disappeared.

Schneller gave a short review of six cases reported from other clinics and four of Saemisch's cases. He concluded by expressing himself decidedly against the existence of cilio-retinal vessels, and expressed the belief that the normal portion of retina derived its nourishment from the macular vessels.

Max Hillemanns[1] reported the other case of Saemisch. It was in a man nineteen years old, who was convalescing from a severe attack of influenza. The heart was normal. A large portion of the fundus had a milky-white appearance. Within this opacity a small triangular island of normal fundus was to be seen on the temporal side of the disc. The apex of the triangle was directed outwards, but did not reach the macula. In the region of the

[1] Hillemanns, *Die Augenaffectionen der Influenza-Erkrankten*, Bonn, 1890.

macula the retina was also opaque. The fovea contained the typical cherry-red spot. A small artery which arose from the edge of the disc crossed the triangle of normal retina. A vein of corresponding size accompanied it. The patient could count fingers eccentrically at 2′. V F was highly contracted.

In 1890 Uhthoff [1] demonstrated two cases before the "Society of Physicians of the Charité," of Berlin. Several days after sudden blindness, the characteristic changes in the fundus were visible, not differing materially from the other cases reported. The V F was contracted and corresponded to a small area of normal retina, which could be seen on the temporal side of the nerve. Later on a number of shining white bodies, similar to those seen in albuminuric retinitis, appeared at the macula. Uhthoff noticed in the beginning of one of these cases a reversed direction of the current of blood in one of the arteries, which he sought to explain in an anastomosis between the ciliary and retinal arteries.

The most recent case published is the one of Perles.[2] The patient, a man of thirty, who had a marked systolic bruit, suddenly became blind in the right eye. When seen ten days later he showed the typical ophthalmoscopic picture of embolism. There was, however, as in the other cases cited, an area (triangular) of normal fundus within the opacity which surrounded the disc. The only normal retinal vessel visible was a small one arising in the disc and distributed to the island of healthy retina. The patient counted fingers at three feet. The V F corresponded to the size and situation of normal retina. The vision afterwards grew to ½. The author attributed this to massage which had been employed.

These sixteen cases are all that I could find in literature.[3] There is no doubt about the diagnosis of any of them, for even in Mauthner's case, which was not seen until four

[1] Uhthoff, *Berliner klin. Wochenschrift*, 1890, p. 825.

[2] Perles, *Centralbl. f. Augenheilkunde*, June, 1892.

[3] There have been reported in this country four other cases of embolism of the central artery of the retina with preservation of a small temporal field. In each case a small vessel with unobstructed circulation was found running from the disc into the unaffected region of the retina, this region lying between the disc and macula in three cases, and to the nasal side of the disc in one, that of Mittendorf's.

Mittendorf, *Trans. Amer. Ophth. Soc.*, 1882.

Wadsworth, *ibid.*, 1890; and *ibid.*, 1896.

Holden, THESE ARCHIVES, 1893, No. 1.—*Ed.*

months after the attack, the history of the case and the condition of the V F and fundus made the character of the trouble certain.

Outside of the ultimate result of the condition, which varied considerably, the cases showed a marked similarity. In all of them a normal area of retina was present within the field of opaque tissue. In the majority of cases it was triangular in form. It seldom extended as far as the fovea. The greatest portion of the macula was usually in the opaque portion, while in one case (Birnbacher) the entire macula remained normal.

The variation in the shape of the unaffected retina is most likely dependent upon the number of vessels supplying the part. It is noticeable that where there was but one vessel the island was triangular, and that otherwise it was elliptical or square. The hypothesis that the cilio-retinal vessels have to do with the nourishment of this portion of the fundus has been vigorously opposed and refuted by Hirschberg, Knapp, and Schneller. The most plausible theory is that the part was nourished by the small macular arteries, which were evidently given off from the main trunk centrally to the embolism. In consequence of this they remained patent.

The functional disturbance varied very little in the different cases. The parts of the retina supplied by the vessels which had become obstructed immediately lost the power of their function. The function of the normal patch was also defective for a time, as the sudden cessation of the circulation in the main arteries caused an alteration in the flow of the small vessels which had remained open. As this was a momentary disturbance, there was no further depreciation of the vision. In those cases where the fovea had remained intact, the vision returned to normal. In Hirschberg's case the vision diminished, and in one of Knapp's the patient became totally blind. Knapp attributed this to the extension of the embolism.

The field was very much contracted in every case. A little variable at first, it soon became stationary, and remained so. Birnbacher reported that in his case it returned

to normal. The field was usually triangular or oval, its greatest extent being, as a rule, towards the temporal side. It usually extended over about 20° horizontally, and 8–10° vertically.

Comparing ours with the above cases, we see that the clear area was not limited to the space between the disc and macula, but extended as a horizontal strip from the nerve to the ora serrata. It could be compared to a peninsula extending into the opaque field instead of an island, as in the other cases. The opaque portion bounded it above and below, forming abrupt borders, both of which contained an empty artery. In Schneller's case a similar artery ran along the upper border of the triangle.

The extent of the preserved area of retina to the periphery in our patient can readily be explained by the presence of the large patent artery, which could be followed far into the periphery. This vessel was evidently given off from the main artery centrally to the embolism. The small macular arteries were hardly of significance, as they later on became atrophic, which did not influence the condition. It was impossible to see how the blood returned from the healthy area. Most likely the superior vein carried it back to the main trunk, for this vein retained a fair size and showed weak pulsation. The existence of a horizontal artery of some size on the temporal side is not as uncommon as is generally supposed. Since I have been observant of this condition I have come across several of them in normal eyes. They pass directly outwards in a slightly tortuous course, a little above or below the horizontal meridian. One of the plates in Liebreich's *Atlas* (Pl. II., Fig. 1) represents a vessel much like the one in this case.

Another striking feature of our case is the condition of the visual field. As the vision was preserved it could readily be measured, and showed an irregular oblong shape, whose upper border just extended to the point of fixation. Its greatest extent was in a direction outward of the point of fixation. As the V F in all of the cited cases corresponded to the area of normal retina, we should in our case have expected a slit-like field with the normal amount of expan-

sion on the inside (50°–55°), whereas it hardly extended 4° to that side. The cause of this becomes evident when we consider the course and distribution of the nerve fibres in the retina. (This subject has been studied and worked out by Wallace, Kölliker, Liebreich, J. Michel,[1] and Dogiel.[2]) While on the whole the nerve fibres of the retina take a radiary course after they leave the nerve, those on the temporal side have a different arrangement. The only ones which take a straight course on that side are the exceedingly delicate fibres which supply the parts between the disc and the nasal edge of the macula. The fibres for the macula, beginning at the upper and lower part of the temporal edge of the disc, take an arched course around the fovea and form a regular semicircle in the outer half of the macula. The fibres which supply the retina beyond the macula arise from the upper and lower edge of the nerve. They supply the parts close up to the macula. As these nerves passed through the necrotic retina in our case, it stands to reason that they were paralyzed, and that the part of the retina supplied by them (beyond the macula) had lost its function, though normal in appearance. But how can one explain the fact that the V F did not extend quite 4° inwards of the point of fixation, which just corresponds with the temporal edge of the macula? Knowing that the blind spot is 6° wide, and that the corresponding diameter of the disc is 1.6 *mm*, every 1 *mm* of retina would represent 3.75° of the V F. Consequently the horizontal diameter of the macula, which is 2 *mm*, would correspond to 7.5° of the V F, which would put its edges not quite 4° from the centre.

Our case gave us an opportunity of observing on the patient conditions which verify the result of anatomical research regarding the nerve distribution.

The unequal extension of the V F in the vertical direction can just as readily be explained. The macula is, as we know, always about 1 *mm* lower than the extended horizontal diameter of the disc. This position of the macula brought

[1] J. Michel, *Beiträge zur Anatomie u. Physiologie*, Leipzig, 1874.
[2] Dogiel, "Ueber die nervösen Elemente in der Retina des Menschen," *Archiv f. mikros. Anatomie*, vol. xl.

its lower edge into the opaque retina in our case. As a natural consequence the excentric vision upwards was destroyed.

The condition of the pupil and its reaction to light was an interesting feature of our case which is deserving of special mention. The reaction to direct rays was never entirely lost, although it was sluggish and less extensive in the beginning of the trouble. After a few weeks it became more prompt and extensive, although it never became as marked as in the normal eye. Consensual reaction and reaction with convergence were always normal. The slow and less extensive reaction in the early part of the trouble had its cause in the same circulatory disturbance mentioned as a cause of the defective central vision at that time.

As the pupillary reaction is a reflex action, depending upon the stimulation of the entire retina by light, the reaction in the cited cases could not return to normal because the sensibility of a large area was lost. The stimulus was consequently less.

A phenomenon more difficult to explain is the reaction, later on, of the pupil to light falling upon the periphery of the retina. The natural inference would be that there is a fallacy in the manner of examination; that the light could not be thrown upon the periphery of the retina without also illuminating the macula, and that this would account for the reaction. To disprove this the patient was seated opposite to and facing a uniformly illuminated wall, which would illuminate the macula as much as could be expected from the reflex rays of the concentrated light. The concentrated light was then thrown into the pupil, at an angle of 45° from the visual line with a lens, but still the pupil contracted further.

It is at present supposed by many (Retzius, Heddaeus, etc.) that there are certain nerve fibres in the retina which govern the reaction of the pupil. Whether we can account for the reaction to peripheric light in our case to this, or whether it has some other cause, I am not prepared to say.

REPORT ON THE OPHTHALMOLOGICAL SECTION OF THE AMERICAN MEDICAL ASSOCIATION AT ATLANTA, MAY 5 TO 8, 1896.

By Dr. H. O. REIK,

OFFICIAL STENOGRAPHER.

1. **Address of the Chairman.** Dr. L. Howe called attention to the too great tendency of ophthalmologists to consider their cases of asthenopia as due entirely to local causes and to ignore the condition of the general health.

2. **A New Nomenclature for Diseases of the Conjunctiva.** Dr. D. S. Reynolds advocates a new nomenclature for inflammation of the conjunctiva, based upon the varying pathological conditions. He makes two general divisions: traumatic conjunctivitis and infectious conjunctivitis, and subdivides these into several groups, designating each species according to its pathological condition.

3. **Sub-Conjunctival Injections.** Dr. E. J. Bernstein believes that by this method the action of drugs is intensified and the dosage made more exact. Reviews all the literature on the subject at length, and in reference to iritis finds the main use of this method in assisting to break up old synechiæ.

Discussion.—Dr. De Schweinitz had tried the injections and believed they should have a permanent place in ophthalmic therapeutics, but not to the exclusion of constitutional measures. Valuable in any variety of iritis, provided there is no high inflammatory action. Called attention to the promptness with which these injections acted in uveitis or episcleritis, but also suggested that relapse was more likely to occur than when ordinary constitutional measures were thoroughly employed. He

had obtained the same results whether bichloride solution or physiological salt solutions were used. Dr. G. C. SAVAGE had used bichloride solution, but found it too painful and thought, no matter what else might be used in iritis, atropine should not be neglected. Dr. C. H. BAKER used the injections in combination with the accepted methods of treatment and had excellent results, especially in interstitial keratitis and central choroiditis. Dr. DUNBAR ROY found this method of service in his hospital work, where he had to deal mainly with colored people. It is cheaper than dispensing medicine, and the physician is sure the remedy is being used.

4. **A Case of Ectropion of the Upper and Lower Eyelids.** Dr. F. C. HOTZ has treated such a case by the use of **cicatricial skin flaps taken from the vicinity of the everted lid.** The cosmetic effect was very good. Dr. Hotz finds several decided advantages in using these flaps. The thin light skin adapts itself nicely to the configuration of the lid and no amount of contraction can cause reversion of the lid because of the firm union of the flap with the tarsus.

5. **The Field of Fixation in its Relation to Heterophoria.** Dr. C. A. WOOD. The author offered an improvement to the methods of making perimetric measurements of the visual field. Instead of using an object attached to the carrier on the perimeter arm, he makes use of four strips of unglazed paper, having printed on them words of two letters placed between, as well as below, figures representing the degrees of latitude on the perimeter arc. These strips are placed together in position on the arm of the perimeter, the patient's head placed in the primary position, and he is asked to read as far away from the centre as possible. The degree of such reading is noted, and in this way the limits of the field in every direction are easily measured. It is more rapid than the older methods and much less fatiguing. The author believes the field of fixation to have wider limits than those set down by Landolt, especially in the downward direction.

6. **Etiological Factors, other than Myopia, in the Production of Retinal Detachment.** Dr. H. O. REIK. An enumeration of the various causes of retinal detachment and a report of a rare case occurring in labor; also a review of the several theories of detachment.

7. **The Anatomical Changes in Two Cases of Retinal Detachment.** Dr. R. L. RANDOLPH. The chief points about the pathological anatomy in the first case were: 1st, the widespread atrophic degeneration of the retinal layers, especially of the layer of rods and cones; 2d, the swelling of Müller's fibres; 3d, the presence of albuminous drops in various localities, especially between the choroid and retina along the neck of the detachment; and 4th, the transformation of the vitreous body into fibrillæ. The principal changes in the second case were the conversion of the vitreous body into fibrillæ and the atrophic degeneration of the anterior portion of the retina. Dr. Randolph concludes that this condition of fibrillary degeneration probably exists to some extent in every case of retinal detachment and that it is the chief element in the pathogenesis of this disease.

8. **The Treatment of Retinal Detachment.** Dr. C. A. WOOD. A review of the many methods of treatment that have been suggested from time to time and an explanation of Deutschmann's recent suggestion to inject sterilized rabbit's vitreous into the eye. Considers this last method an important one to think of, but concludes with the warning that we should not be too hasty to consider any method as successful because of a few cures occurring under its use, knowing, as we do, that cases recover spontaneously.

9. **Electrolysis in the Treatment of Detached Retina.** Dr. W. T. MONTGOMERY. Reports four cases treated according to Dr. Terson's method of using electrolysis. His conclusions are that the treatment is exceedingly painful, valueless as a curative agent, and that it may excite inflammatory glaucoma, as it did in one of these cases.

10. **Report of One Hundred Cataract Cases.** Dr. LYMAN WARE. Of the one hundred operations, only 5 per cent. were failures. The author advises preliminary iridectomy and thorough antisepsis, and says that where there is no disease of the eye, aside from the cataract, and when the patient is reasonably tractable, every operation ought to be a success.

Discussion.—In the discussion, Dr. MONTGOMERY opposed the preliminary iridectomy, the use of bichloride as an antiseptic solution, and the necessity for a large corneal section. He only rarely does an iridectomy, and prefers boracic-acid solution to bichloride, because the latter sometimes causes irritation. Dr. J. A.

WHITE thought there was no doubt that if we considered only the advantages to the patient it was best always to do a preliminary iridectomy. He was not afraid of irritation from the use of bichloride, but used it freely, and he favored a large corneal section in every case. Dr. CARR spoke in favor of preliminary iridectomy, and Dr. YOUNG followed, favoring simple extraction. Dr. G. C. SAVAGE thought that the ideal method of extraction had not yet been found, and that when done it would consist of removing the lens in its capsule without iridectomy. He always starts out with the intention of doing a simple extraction, but prepared for iridectomy, if necessary. Dr. RANDOLPH thought that the effect of antiseptic solutions was largely due to their mechanical application, and that we should get just as good results from the use of salt solution or even boiled water as we do from bichloride. His best results, as regards vision, have been obtained in those cases in which he performed a preliminary iridectomy.

11. **Cases of Optic Nerve Atrophy of Obscure Origin Occurring in General Diseases.** Dr. H. V. WÜRDEMANN. Optic-nerve atrophy occurs in general diseases usually as a result of direct irritation from their toxines, causing inflammation with resultant interstitial changes or through necro-biosis in the blood-vessels, affecting the nutrition of the nerve and retina. Although many cases are apparently of obscure origin, in the majority it is possible to demonstrate a sufficiently exciting cause.

12. **Optic-Nerve Atrophy from Toxic Agents.** Dr. G. E. DE SCHWEINITZ. The baneful influence of certain toxic agents falls particularly upon the papillo-macular tract and there produces augmentation of nuclei, atrophy of the connective tissue, and wasting of the nerve fibres, the process being most intense, according to SACHS, in one small area, which he calls the nuclear group. There is, in fact, an interstitial sclerosing inflammation comparable to the same pathological process visible in interstitial hepatitis. The history of sixteen autopsies was given, but as all the patients suffered with other widespread diseases, the author concludes that we are not yet in possession of the results of an autopsy on a perfectly pure case of toxic amblyopia. When, however, a given set of clinical symptoms are taken into consideration with the results of the autopsies thus far recorded, we have reason to believe that the pathological process which determines toxic am-

blyopia is situated in the optic nerve, and especially in that portion known as the papillo-macular bundle. The magic-lantern was used to show the progressive changes in the central scotoma. The drugs producing such changes are tobacco, alcohol, stramonium, cannabis indica, chloroform, opium, cocaine, bisulphide of carbon, nitro-benzole, arsenic, lead, iodoform, the toxine of diabetes, and probably idoduret and thiuret, two modern antiseptic preparations. Of all of them, tobacco is the principal one.

13. **Optic-Nerve Atrophy of Obscure Spinal Origin.** Dr. DUNBAR ROY. A review of the cases recorded, showing the relation existing between optic atrophy and such diseases as meningitis, locomotor ataxia, multiple sclerosis, lateral sclerosis, tropho-sclerosis, chorea, and injuries to the spinal cord.

14. **Differential Diagnosis between Simple Glaucoma and Optic Atrophy.** Dr. B. A. RANDALL. This is a diagnosis which, as a rule, of course, gives no trouble ; but there are cases in which both the history and the ophthalmoscopic appearances are so slight as to make the diagnosis most difficult.

Discussion.—Dr. C. A. WOOD thought that alcohol was more likely to be the principal cause of toxic amblyopia than tobacco, because the former is known to produce nerve lesions elsewhere in the body while the latter is not. Dr. SAVAGE thought there should be no difficulty in distinguishing glaucoma from atrophy at any time. Dr. STIRLING believed that in England and Scotland the principal cause of toxic amblyopia was tobacco, while in France it was alcohol, and gave as the reason for this that in the first named countries light liquors but the strongest kinds of tobacco are used, while in France this is just reversed. Cases of optic atrophy due to tobacco were reported by Drs. BAKER and WOODSON ; to sunstroke, by Drs. BAKER and HIGGINS ; and to spinal injury, by Drs. HOBBY and SHORT.

15. **Idiopathic Choroiditis.** Dr. A. E. PORTMAN. A reminder that not all cases of choroiditis are specific in their origin, and a consideration of that form which creeps on in an insidious manner.

16. **A Case of Total Blindness Possibly Due to an Over-dose of Quinine.** Dr. H. B. ELLIS. A case of toxic amblyopia following the use of quinine, but the patient was also addicted to the use of morphine and whiskey.

17. **A Contribution to the Question of Removal of the Lens in Myopia.** Dr. HERBERT HARLAN. Reports the case of a woman, aged forty-five, with progressive myopia, causing loss of vision in the left eye. The right was injured when thirteen years old, absorption of the lens followed, and the vision here is now $\frac{20}{20}$ without glasses, and no fundus trouble apparent. Would an early operation have saved the left eye?

18. **Results of an Examination of the Vision of the Children in the Public Schools of Baltimore.** Drs. HARLAN and WOODS. The plan pursued in the examination was the same as that reported some time ago by Dr. F. Allport of Minneapolis. The eyes of 53,000 pupils were tested, and a little over 43 per cent. of these were found to have $\frac{20}{20}$ vision in each eye. The examinations brought about a great abuse of the dispensary privileges, but the results on the whole are very encouraging.

The Association will meet in Philadelphia next year. President of the Ophthalmological Section, Dr. G. E. De Schweinitz of Philadelphia; Secretary, Dr. Starkey of Chicago.

SYSTEMATIC REPORT ON THE PROGRESS OF OPHTHALMOLOGY IN THE FIRST QUARTER OF THE YEAR 1896.

By Dr. ST. BERNHEIMER, in Vienna; Prof. C. HORSTMANN, in Berlin; and Dr. P. SILEX, in Berlin;

WITH THE ASSISTANCE OF

Dr. S. M. Burnett, Washington; Dr. Dantone, Rome; Dr. Herrnheiser, Prague; Prof. Hirschmann, Charkow; Dr. P. von Mittelstädt, Metz; Dr. Sulzer, Geneva; Dr. L. Werner, Dublin; Dr. C. H. A. Westhoff, Amsterdam; Dr. Schiötz and Dr. Ole Bull, Christiania; Dr. R. Greeff, and Dr. Deus, Berlin; and others.

Translated by Dr. Ward A. Holden.

Sections I.–V. Reviewed by Dr. ST. BERNHEIMER.

I.—GENERAL OPHTHALMOLOGICAL LITERATURE.

TREATISES ON GENERAL, BIBLIOGRAPHICAL, AND HISTORICAL SUBJECTS. STATISTICAL REPORTS.

1. Neese. The eye hospital of the Popows. 13 years of service. 188 folio pages with 6 plates. Kiew, 1896.

2. Ophthalmic Hospital of Cincinnati. Report for 1895.

3. Massachusetts Charitable Eye and Ear Infirmary. 70th Annual Report, 1893.

4. Brooklyn Eye and Ear Hospital. 27th Annual Report, 1895.

4a. N. Y. Eye and Ear Infirmary. 75th Annual Report, 1895.

5. Manhattan Eye and Ear Hospital. 26th Annual Report, 1895.

6. BUFFALO EYE AND EAR INFIRMARY. 19th Annual Report, 1895.

7. NEW YORK OPHTHALMIC HOSPITAL (Homeopathic). 44th Annual Report, 1895.

8. NEW AMSTERDAM EYE AND EAR HOSPITAL. 7th Annual Report, 1895.

9. PRESBYTERIAN EYE, EAR, AND THROAT CHARITY HOSPITAL, of Baltimore. 18th Annual Report, 1895.

10. NEWARK CHARITABLE EYE AND EAR INFIRMARY. 16th Annual Report, 1895.

11. HARLEM EYE, EAR, AND THROAT INFIRMARY. 14th Annual Report, 1895.

12. NEW YORK OPHTHALMIC AND AURAL INSTITUTE. 26th Annual Report, 1895.

13. DAZENKO. The value of travelling eye commissions. *Wratsch*, 1896, No. 8.

This excellent report (1) contains a detailed history of the founding and extension of this institution, which was endowed by Popow and his wife. The 54 beds are given to 14 trachoma patients, 17 operative patients, 14 patients with non-contagious and 4 with contagious eye diseases, 2 private patients, and 5 beds are reserved. There are also accommodations for needy out-patients, mostly pilgrims. The total number of patients was 18,441, of which 3500 were in-patients. Conjunctival diseases furnished 32.1 per cent., and corneal diseases 27.8 per cent. of the total number ; 25 per cent. were trachoma. In the treatment of the latter the author criticises the excision of the cartilage and of the retrotarsal folds, which he has found injurious, but in severe cases he recommends canthoplasty and the expression of the follicles by means of the fingers, forceps, or Schroeder's wire brush, and also the method of Keinig.

In pannus, syndectomy is recommended. The splitting of the canaliculi and the probing of the nasal duct when there are lachrymal complications, help the pannus. The total number of operations was 3938, with 1145 extractions. By careful antiseptic precautions the losses have been reduced to 1 per cent. In complicated cases preliminary iridectomy is done, and, if possible, the lens is removed in its capsule. Iridectomy and not sclerotomy is done for glaucoma.

In the long section on the oncology of the eye there are described (1) a case of choroidal sarcoma carcinomatosum or alveolare melanoticum; (2) a case of fibrous angioma of the orbit; (3) a case of fibro-sarcoma of the sclera; and (4) a case of precorneal epithelioma. HIRSCHMANN.

The total number of cases treated at the Ophthalmic Hospital of Cincinnati (2) during 1895 was 2286. There were 12 simple extractions and 8 with an iridectomy—372 operations in all, including the minor ones. BURNETT.

The number of new eye patients at the Massachusetts Charitable Eye and Ear Infirmary (3) during 1895 was 14,204. The number of operations was 1599, including the minor. There were 189 extractions, tabulated in the accurate form we are accustomed to find in these reports, by Dr. Standish. Of these, 90 were combined, 77 of whom had vision 0.1 and better. The simple extractions were 44, of whom 38 had vision 0.1 and better. There were 24 extractions with a button-hole in the iris, 21 of whom had V = 0.1 and better. In the 44 simple extractions there was prolapse of iris in 4 cases. In the cases where a button-hole was made in the iris there was no prolapse of iris. There were 31 operations for traumatic and other cataracts not senile, 15 of whom had V of 0.1 and better. BURNETT.

The number of new eye patients treated at the Brooklyn Eye and Ear Hospital (4) during 1895 is 9328. The total number of operations, including the minor, is 1223. The extractions with iridectomy, 27; without iridectomy, 12. No statistics of results given. BURNETT.

In the New York Eye and Ear Infirmary 18,926 new eye patients were registered. 146 senile cataracts extracted, 17 with, 129 without iridectomy. The Infirmary showed an unprecedented growth in the last year. KNAPP.

The total number of eye patients registered at the Manhattan Eye and Ear Hospital (5) for the year ending September 30, 1895, was 12,412. The operations were 1511, including the minor. Simple extractions 67. Modified extractions 18. No statistics of results given. BURNETT.

During 1895 there were treated at the Buffalo Eye and Ear Infirmary (6) 1840 new eye cases. There were 9 simple extractions of cataract and 3 with iridectomy—in all 151 operations on the eye, not including the minor. BURNETT.

During the year 1895, 17,561 eye cases were treated at the New

York Ophthalmic Hospital (Homeopathic) (7). There were 3 extractions with iridectomy, 35 with preliminary iridectomy, and 21 without iridectomy. BURNETT.

The number of eye patients treated at the New Amsterdam Eye and Ear Hospital (8) for the year 1895, was 1712. Simple extractions 7. BURNETT.

During 1895, 7649 cases were treated in the eye department of the Presbyterian Eye, Ear, and Throat Charity Hospital of Baltimore (9). There were 130 extractions without iridectomy and 57 with iridectomy. No results noted. BURNETT.

The Newark Eye and Ear Infirmary (10) treated 3594 eye patients during 1895. Simple extractions 12, combined 16. BURNETT.

The Harlem Eye, Ear, and Throat Infirmary (11) treated 1285 eye patients in 1895. The operations numbered 51 with 3 extractions.

In the eye department of the New York Ophthalmic and Aural Institute (12) there were treated during 1895, 8055 new cases. There were 671 operations performed, excluding the minor, of which 144 were extractions of cataract. Of these 17 were hard cataracts with iridectomy, with one failure; and 89 without iridectomy, with one failure. BURNETT.

DAZENKO (13) believes that the organization of small permanent stations for eye treatment in rural districts is preferable to the travelling commissions, which do not fulfil their intended purpose. HIRSCHMANN.

II.—GENERAL PATHOLOGY, DIAGNOSIS, AND THERAPEUTICS.

14. LEBER. The present status of our knowledge of the exchange of fluids in the eye. *Ergebnisse der Anatomie und Entwicklungsgeschichte,* edited by Merkel and Bonnet, vii., p. 143.

15. HENRY, R. WALLACE. The light perceptive power as an aid to diagnosis and prognosis in diseases of the eye. *Ophth. Review,* xv., p. 33.

16. MACKAY, GEORGE. Eyesight and the public services. *Trans. Ophth. Soc. Un. K.,* xv., p. 199.

17. DE SCHWEINITZ. Experimental salicylic-acid amblyopia. *Trans. Amer. Ophth. Soc.,* Dec., 1895.

HENRY (15) gives a brief sketch of our knowledge of light perception in its practical application. Two objections to photo-

meters in use are, that the source of light is not constant, and that the form sense is also taken into account. In the author's photometer the source of light is constant, and the intensity is altered by interposing nine opal discs of standard density. Patients are kept five minutes in a dark room to allow for adaptation. The results show that the light perceptive power (light minimum perception) is greatest in early and middle life and diminishes with age. The loss of one eye seems to increase the light perceptive power in the other. For practical purposes it is assumed that the power of adaptation is the same in diseased eyes. The author finds some diminution of L. P. in toxic amblyopia, hemeralopia. The L. P. does not vary to any marked extent with the form sense. Those diseases which affect the retina either by pressure or poisoned condition of blood cause most diminution of the L. P. If the L. P. in a case of apparent toxic amblyopia be four or under, the urine should be examined. In anæmia the L. P. is about normal, also in miners' nystagmus.

WERNER.

As a result of the discussion on MACKAY's (16) paper the following resolution was adopted: "That in the opinion of this society no examination of eyesight is fair or satisfactory which depends merely upon the examination of the form-vision by test types and dots, and omits an estimation of the refraction." Further, "That the Society appoints the President, Messrs. Henry Power, Nettleship, Lawson, Cooper, Brailey, and Hartridge to accompany the deputation of the British Medical Association to give expression to the foregoing resolution." WERNER.

In his experiments on dogs DE SCHWEINITZ (17) has demonstrated that the toxic effects of salicylic acid on the optic nerve and retina are the same as those of quinine, only in a milder degree. There may also be conjunctivitis and corneal haziness leading to ulceration. BURNETT.

III.—INSTRUMENTS AND REMEDIES.

18. VAN DUYSE. The Roentgen rays in surgery. *Arch. d'opht.*, xvi., No. 2, p. 101.

19. KOSTER. A note on the effect of cocaine on the accommodation. *Nederlandsche Oogheelkundige Bydragen*, i., p. 5, 1896.

20. STRESCHEMINSKY. Formalin in ocular therapy. *Wratsch.* 1896, No. 2.

21. TSCHEMOLOSSOFF. Formaldehyde as a preservative in preparing microscopic gelatine specimens of the eye retaining the transparency of the refractive media. *Ibid.*, No. 1.

(The specimens retain their normal color, and neither become opaque nor shrink.)

22. DARIER. On the permeability of the eye to the Roentgen rays. *Soc. d'opht. de Paris*, March, 1896.

23. ROGMAN. On the employment of dry compresses and powders in the treatment of eye diseases. *Ann. d'ocul.*, CXV., p. 193.

24. BURNETT, SWAN M. The use of formalin in ophthalmic practice. *Ophth. Rec.*, March, 1896.

25. SUKER, G. F. Ephidrene hydrochlorat. *Annals of Ophth. and Otol.*, Jan., 1896.

26. VEASEY, C. A. A case of duboisine poisoning. *Philada. Polyclinic*, March 28, 1896.

VAN DUYSE (18) succeeded in demonstrating with the Roentgen rays the presence of particles of lead in the posterior chamber and in the vitreous behind the lens in rabbits' eyes, and also in enucleated human eyes. He describes the procedure in the case of the living eye, it sometimes being necessary to produce exophthalmus. V. MITTELSTÄDT.

KOSTER (19) found, after dropping five per cent. cocaine three times into his own eye, that the accommodation was nearly abolished. The maximum effect was observed after twenty minutes, and persisted only fifteen minutes longer.

STRESCHEMINSKY (20) found that formalin has less effect than the usual remedies in cases of catarrhal conjunctivitis, has no effect in cases of purulent and gonorrhœic conjunctivitis and trachoma, but acts well in cases of corneal ulcer, and particularly serpent ulcer when atropine is used at the same time.

HIRSCHMANN.

DARIER (22) showed by several cuts that the ocular media possess but slight permeability for the X-rays. This is perhaps the reason that these rays are invisible.

Convinced by laboratory experiments that a sterile dry absorbing dressing is the best means of curing and preventing infectious processes in the eye, ROGMAN (23) has dusted thioform into the conjunctival sac, and used an occlusive bandage. This method

of treatment is especially recommended for infectious corneal ulcers, phlyctenulæ with excessive conjunctival secretion, corneal lesions with trachoma, and eczematous blepharitis. SULZER.

BURNETT (24) has used formalin in muco-purulent conjunctivitis in the strength of 1 to 2000 with much satisfaction, and also in infecting ulcers of the cornea, touching them with 1 to 200 or 1 to 60 solution once a day, and using 1 to 2000 as a collyrium. The strong germicidal quality of formaldehyde and its power of penetrating the tissues make it a most valuable antiseptic in all infecting diseases of the eye or its adnexa.

SUKER (25), following the suggestion of Misera of Tokio, has used hydrochlorat of ephidrene as a mydriatic, and finds that a ten per cent. solution produces a mydriasis, not associated with accommodative paralysis, in from ten to twenty minutes. No untoward symptoms have been observed from its use as a simple mydriatic. BURNETT.

In VEASEY'S (26) case a profound toxic effect was produced in a woman by the instillation into the conjunctival sac of a single drop of duboisine sulph. containing probably $\frac{1}{240}$ of a grain of the drug. The symptoms were those usually observed in such cases. BURNETT.

IV.—ANATOMY.

27. BERNHEIMER, ST. On localization in the region of the oculomotor nucleus. *Wiener klin. Wochenschr.*, 1896, No. 5, p. 73.

28. ALT. On E. Treacher Collins's so-called glands of the ciliary body. *Amer. Journ. of Ophth.*, Jan., 1896.

29. NORRIS. The terminal loops of the cones and rods of the human retina. *Trans. Amer. Ophth. Soc.*, 1895.

BERNHEIMER (27) extirpated one or more of the extrinsic eye muscles of rabbits with the following results:

12–15 days after the extirpation Nissl's stain showed changes in the ganglion cells of the oculomotor nucleus similar to those obtained by Nissl in the nucleus of the facial. These changes, which were found only when the muscle had been entirely extirpated, consisted first in the destruction of the cell body and later of the nucleus. The cells became round and the processes disappeared.

When all four extrinsic muscles of one eye were extirpated, and forty-five sections were made through the oculomotor nucleus

fourteen days later, it was found that in the first thirty sections, representing the distal and middle thirds of the nucleus, a great number of cells were degenerated both to the right and the left of the median line, but more on the side opposite the operation. In the proximal third of the centre the degenerated cells were fewer in number, and in the last ten sections only normal cells were found on both sides of the median line.

Therefore it appears that in the rabbit the four extrinsic muscles supplied by the oculomotor nerve are in connection with the ganglion cells of the distal and middle thirds of the nucleus, and more particularly with the cells of the opposite side, while the nerve fibres for the intrinsic muscles are to be sought for in the proximal portion of the nucleus.

The author expects to add to his results by further experiments, and particularly by experiments on monkeys.

ALT (28) has made numerous examinations after Collins's method in order to determine if the structures described by Collins are really glands. He finds these projections simply pegs of cells going outward from the pigment-epithelium layer and with no glandular structure whatever. They are only folds due to the play of the ciliary muscle, like the ridges on the iris. Eleven photo-micrographs accompany the paper. BURNETT.

NORRIS (29) exhibited a number of photographs of retinal sections made by Dr. James Wallace, showing the loops in which the rods and cones terminate in the human retina, to which attention was first called by Pacini. The reviewer would like to state that he has seen those terminal loops most distinctly in some sections of the retina he has in his possession, made by Dr. W. M. Gray at the Army Medical Museum. BURNETT.

V.—PHYSIOLOGY.

30. CHARPENTIER. Retinal oscillations consecutive to luminous impressions. *Acad. des Sciences*, Jan. 13, 1896.

31. DOR. The action of light on the nuclei of the rods and cones. *Soc. des Sciences de Lyon*, Jan., 1896 ; *Ann. d'ocul.*, CXV., p. 224.

32. AHLSTRÖM. On light perception in the periphery of the visual field. *Ann. d'ocul.*, CXV., p. 200.

33. FRÖHLICH. In what circumstances do double images

appear to be at unequal distances from the observer? *Graefe's Archiv*, xli., 4, p. 134.

34. KOSTER. Investigations on the color sense. *Ibid.*, p. 1.

35. HESS, C. Studies in accommodation. *Ibid.*, xlii., 1, p. 288.

36. KOSTER. Accommodation and convergence when the eyes are turned to the side. *Ibid.*, p. 140.

37. GREEN, JOHN. Note on the variations in the power and astigmatism of thin spherical, toric, and cylindrical lenses in principal cases of oblique centrical refraction. *Trans. Amer. Ophth. Soc.*, 1895.

With the expression retinal oscillations, CHARPENTIER (30) characterizes the ensemble of a luminous impression and its after-images, which he thinks are composed of positive and negative phases of excitation. The fact that in certain conditions the positive retinal image is followed by a colorless or bluish after-image is not to be explained, he thinks, as a special excitation of the violet fibres or as an excitation of the rods exclusively, but he regards this phase as a maximum of the gradually decreasing excitation; it is always separated from the primitive image by a dark after-image.

The purpose of AHLSTRÖM'S (32) experiments was to compare the light sense of the periphery of the retina with that of the central portion. Aubert believed that the light sense is equal in the entire extent of the retina, and Charpentier arrived at the same conclusion from experimenting with his photometer. Schadow and Buty, by another method, arrived at the opposite conclusion. In all these experiments the test objects were too large to obtain accurate results. Ahlström arranged an incandescent lamp on a perimeter arc of 2 *m* radius and allowed the light to pass through an opening of varying size. He found that the light sense is not the same for all portions of the retina but that it is greatest in the fovea and near it and diminishes uniformly toward the periphery. In order to bring out the difference it is necessary to use sources of light of small surface. The fatigue and adaptation of the retina may give rise to phenomena which in a certain measure seem to contradict these results.

FRÖHLICH (33) believes that the chief factor in causing one of two double images to appear nearer is the influence of the neighborhood. A second factor is the apparent greater brightness of

an object seen excentrically, it therefore seeming nearer. When both these factors are eliminated, the answers of the observer are confused.

HESS (35) in a polemic article again refutes the assertions of Fick who believes in unequal accommodation.

According to KOSTER (36) when looking to one side both eyes accommodate equally and the amount of accommodation corresponds to the distance of the object from the eye of the same side. The convergence of the lines of vision in looking to one side is less than when the eyes are accommodated equally for an object in the median line. In passing from a convergent position in the median line to one laterally, the accommodation remaining the same, the eye on the same side must pass through a greater angle of rotation than the eye on the other side.

The near point of binocular accommodation is removed as soon as the deviation from the middle line passes 20°, and this increases with the angle. This is doubtless due to the insufficiency of relative and absolute convergence which is caused by the mechanical obstacle to the lateral deviation of the eye on the other side.

This paper of GREEN'S (37) is a purely mathematical one and only the conclusions can be given. It is proven that when a spherical lens is tilted forward through an angle of 15°, the maximum increase in the power of the lens is less than one fourth of the maximum increase in power when the lens is tilted forward through an angle of 30°.

BURNETT.

Sections VI.–XI.—Reviewed by PROF. HORSTMANN.

VI.—ANOMALIES OF REFRACTION AND ACCOMMODATION.

38. DARIER. On injuries of the crystalline system. *Soc. d'opht.*, 1896, Feb. 3.

39. MOLL. 150 cases of post-diphtheritic paralysis of accommodation. *Centralbl. f. prakt. Augenheilk.*, 1896, p. 2.

40. SCHIRMER. The post-diphtheritic affections of the eye. *Sammlung zwangloser Abhandlungen aus dem Gebiete der Augenheilk.*, i., 4.

41. WRAY. The extraction of transparent lenses in high myopia. *Trans. Ophth. Soc. Un. K.*, xv., p. 233.

42. MITTENDORF. Four thousand cases of ocular headaches and the different states of refraction connected therewith. *Trans. Amer. Ophth. Soc.*, 1895.

DARIER (38) believes that traumatic myopia depends upon a stretching of the zonula, and in these cases he used eserine and the galvanic current. His paper contains several interesting case-histories of traumatic myopia and luxation of the lens. In one case a luxation of the lens was spontaneously reduced after a single instillation of eserine, before the effect of the eserine had been manifested in the iris. Immediately after the reduction there was myopia of 7 D, which in the course of treatment was reduced to 4, 3, and finally a myopic astigmatism of 1.5 D.

SULZER.

MOLL (39) reports 150 cases of paralysis of accommodation, in all of which, except three, diphtheria of the throat or nose has preceded. The paralysis began from two to eight weeks after the beginning of the diphtheria. It lasted on an average four weeks. Its onset was always sudden and its passing off gradual. Only rarely was there paresis of the sphincter pupillæ. In 16 cases both sixth nerves were paretic, but the other extrinsic muscles retained their function.

SCHIRMER (40) first describes the paralysis of accommodation that follows diphtheria. This appears from one to six weeks, and mostly three weeks, after recovery from the throat affection. The usual duration is four weeks. The prognosis is always good. The sphincter is rarely affected, and the external rectus is the only other ocular muscle ever affected.

The most interesting feature in MITTENDORF'S (42) statistics of ocular headaches is that more than 4 per cent. were caused by an astigmatism of 0.5 or less. He has frequently seen the headaches disappear under the use of $\frac{1}{8}$ diopter cylinder, and he uses these weak cylinders often.

BURNETT.

VII.—LIDS.

43. PRAUN. A simplification of Panas's operation for entropium. *Zehender's klin. Monatsbl.*, xxxiv., p. 99.

44. UHTHOFF. A further contribution to blepharoplasty. *Deutsche med. Wochenschr.*, 1896, No. 11.

45. SILEX. On the formation of a lid with unpedunculated skin flaps. *Zehender's klin. Monatsbl.*, xxxiv., p. 46.

46. WOLFF. The ptosis operation. *Berl. klin. Wochenschr.*, 1896, No. 24.

47. FUCHS, E. On blepharochalosis. *Wiener klin. Wochenschr.*, 1896, No. 7.

48. TERSON. Notes on a new hemostatic forceps for lid operations, and a "*griffe*" for enucleation. *Ann. d'ocul.*, cxv., p. 106.

49. BERNHARDT. Report of a case of synchronous movement of a drooping lid and the lower jaw. *Centrabl. f. prakt. Augenheilk.*, 1896, p. 7.

50. WADSWORTH. An adenoma of the Meibomian glands. *Trans. Amer. Ophth. Soc.*, 1895.

51. HARLAN. Two cases of congenital entropion of both upper lids, with deficiency of the tarsi; transplantation of a flap of skin into the lid margin. *Ibid.*

52. TANSLEY. A congenital ptosis case and operation. *Ibid.*

In a man of sixty-one, whose entire lower lid had been removed for carcinoma, UHTHOFF (44) made a blepharoplastic operation according to Fricke. Since after this the new-formed lid rolled inward, its inner surface was covered with a large flap of mucous membrane from the lower lip. The result was satisfactory.

SILEX'S (45) patient, a woman of twenty-four, who had lost the eyelids from syphilitic ulceration, was operated on by transplanting skin flaps from the arm, with satisfactory results and improvement of the keratitis.

According to WOLFF'S (46) investigations, the main tendon of the levator palpebrarum is inserted into the anterior surface of the tarsus, about 5 *mm* from the free margin of the lid. To relieve ptosis, he makes an incision in the skin over the convex margin of the tarsus, seizes the tendon, and passes two squint hooks beneath it. The muscle is then tied, divided lower down, and united with sutures to its place of insertion. Wolff also operates from the conjunctival side. The upper lid is everted, and a fold of conjunctiva is seized near the upper margin of the tarsus and perforated by a cut with scissors. The conjunctival flap is turned out and the levator exposed. The muscle is then resected and the ends united with sutures.

Blepharochalosis is the name given by FUCHS (47) to an atrophy of the skin of the lids with thinning and loss of elasticity

and a consequent sagging. There is also atrophy, or at least relaxation of the subcutaneous cellular tissue. The small veins of the skin are dilated, and there is a slight ptosis.

For facilitating suturing in ptosis operations, TERSON (48) makes use of his forceps, which have the compressing ring open upward. He has also devised a perforated spoon for the purpose of fixing the eyeball and forcing it forward when the optic nerve is to be cut. [Old, devised by Wells.—H. K.]

BERNHARDT'S (49) patient was a boy of nine, with congenital left ptosis. In opening the mouth wide, chewing, or moving the lower jaw laterally from *left to right*, the drooping lid moved synchronously.

The patient of WADSWORTH (50) was a young man of eighteen, with a tumor occupying the middle of the edge of the upper lid of the left eye. The eye had been operated on before for a growth of some kind. It measured 25 *mm* vertically, 20 *mm* horizontally, and 15 *mm* in thickness. The whole thickness of the lid, including the tumor, was removed and the wound closed by sliding flaps from either side of the lid. The tumor of the tarsus contained a number of cysts, and the histological examination showed it to be an adeno-cystoma, originating in the Meibomian glands. BURNETT.

In the first of HARLAN'S (51) cases, a negro girl of five years, there was complete entropion of the right upper lid and an entropion of the nasal third of the upper lid of the left eye. The tarsus was represented by a narrow band of 4 *mm* width along the edge of the lid, but was thicker than the normal tarsus. On the conjunctival side there were two horizontal grooves 5 *mm* long, separated by a bridge of conjunctiva beneath which a probe could be passed. The conjunctiva and tarsus seemed only in opposition and not united.

In the right eye the lid was created by Green's operation. In the left, on account of a deficiency of tissue in the portion affected by entropion, it was found necessary to make a transplantation of a piece of skin to the lid margin, laid bare by the incision of Arlt. The flap united well and the cornea became clear of the opacities resulting from the attendant keratitis. The second case, in many particulars like the first, was in an infant six weeks old, who was the subject of ophthalmia neonatorum, but recovered with only slight maculæ of the cornea. It is remarkable that it had the same openings in the palpebral conjunctiva as the first case. No treat-

ment was attempted in the latter case, which was also seen by and was under the care of De Schweinitz. BURNETT.

TANSLEY'S (52) method of operating is as follows: He first dissects off a vertical ribbon of skin, a quarter of an inch wide, beginning just below the brow and ending two lines from the middle of the edge of the lid. He then denudes the tarsus and removes a semilunar piece of skin corresponding to it, leaving a vacant space which is filled by drawing the two opposing edges of the wound together. The ribbon is then inserted through an opening made under the skin of the brow and brought out and sutured a few millimetres above the brow. The edges of the semilunar wound are also sutured. The effect of the whole is to elevate and hold permanently in place the edge of the upper lid.

BURNETT.

VIII.—LACHRYMAL APPARATUS.

53. GALOVINE. Displacement of the lachrymal glands. *Arch. d'opht.*, xvi., 2, p. 104.

54. PICK. On tumors of the lachrymal gland. *Centralbl. f. prakt. Augenheilk.*, 1896, p. 97.

55. SCHROEDER. Two further cases of actinomycosis of the canaliculus. *Zehender's klin. Monstabl.*, xxxii., p. 116.

56. FRÖHLICH. On the treatment of disease of the lachrymal sac. *Ibid.*, p. 26.

57. NOYON. On obliteration of the tear sac in chronic dacryocystitis. *Nederlandsche Oogheelkundige Bydragen*, i., p. 9, 1896.

58. VULPIUS. The treatment of stenosis of the nasal duct. *Deutsche med. Wochenschr.*, 1896, No. 7.

59. STEPHENSON S. Supernumerary caruncula lacrymalis. *Ophth. Review*, xv., p. 8.

60. WOODWARD, T. ST. An addition to the usual methods of treating epiphora. *Ann. d'ocul.*, cxv., p. 107.

In a man of eighteen, GALOVINE (53) observed the rare condition of displacement of both lachrymal glands, which had come on gradually in the course of three years. Six months before, the patient had suffered from mumps without any affection of the lids. In both of the drooping upper lids there is a fold of skin concealing the outer commissure and a portion of the ball. The gland, which lies in the fold of skin, can readily be pushed back into the orbit. On the right side the author removed the gland

and the superfluous skin and sewed up the wound. On the left side the tarso-orbital fascia was opened and the gland pushed up into the orbit where it was fixed with sutures. Then the skin and a part of the fascia that had been pushed forward by the gland were excised and the margins of the wound sutured. The other wound was closed after the manner of Hotz's entropium operation. The result was satisfactory, but better on the side where the gland was retained. The extirpated gland showed chronic interstitial inflammation with degeneration of the epithelium.

v. MITTELSTÄDT.

In PICK's (54) patient, a tuberculous woman, aged forty-six, there was a large, painful tumor at the site of each lachrymal gland, which were removed. The glandular tissue was pervaded with granulation tissue.

In one of SCHROEDER's (55) two cases of actinomycosis of the canaliculus, a portion of the granulation tissue removed from the canaliculus after splitting it showed that the fungus had also extended into the conjunctiva. Notwithstanding this the canaliculus healed up in two days. HIRSCHMANN.

FRÖHLICH (56) injects a five-per-cent. solution of cocaine into the tear sac, and then, after covering the entire conjunctiva and cornea with vaselin to prevent cauterization, he injects a ten-per-cent. solution of chloride of zinc into the sac. After three minutes this is removed, and a four-per-cent. solution of soda injected in order to neutralize the zinc. The following day the sac is washed out with bichloride. It is rarely necessary to repeat the cauterization.

NOYON (57) divides the skin above the dilated tear sac under chloroform. The section is above and below, and the internal ligament is cut. Callous fistulæ are cut around and removed. The mucosa of the exposed sac is then scraped away with a sharp spoon, and as soon as the hemorrhage ceases, it is cauterized with the Pacquelin cautery and the sac stuffed with iodoform gauze. Recovery takes place in two or three weeks. WESTHOFF.

VULPIUS (58), in cases of stenosis of the nasal duct, recommends the continued wearing of sounds, as Schweigger used them in 1869, and later gave them up.

STEPHENSON'S (59) patient, a girl of fourteen, had a small granular tumor on the palpebral conjunctiva, directly behind the lower punctum. Its histological structure was the same as that of the normal caruncle. WERNER.

In cases of epiphora, WOODWARD (60) recommended the complete extirpation of the caruncle and the removal of the posterior wall of the lower canaliculus. SULZER.

IX.—MUSCLES AND NERVES.

61. JAVAL. A theoretical and practical manual on strabismus. Masson, Paris, 1896.

62. PANAS. On the elongation of the ocular muscles in the treatment of non-paralytic strabismus. *Arch. d'opht.*, xvi., 1, p. 1.

63. KOSTER. Artificial strabismus convergens. *Nederlandsche Oogheelkundige Bydragen*, i., p. 7, 1896.

64. STOEWER. On the operation for paralytic squint. *Zehender's klin. Monatsbl.*, xxxiv., p. 86.

65. FEILCHENFELD. Unilateral isolated congenital paralysis of the abducens.

66. SILEX. On partial, isolated paresis of the orbicularis palpebrarum. *Arch. f. Augenheilk.*, xxxii., p. 95.

67. BULL, C. S. Preliminary report on 612 cases of convergent squint, with the final results of operation. *Trans. Amer. Ophth. Soc.*, 1895.

68. DE SCHWEINITZ. Recurrent oculomotor palsy, with a case. *Ibid.*

69. OPPENHEIMER, H. S. The use of strychnia in insufficiency of the interni. *Ibid.*

70. SAVAGE, G. C. Sthenic and asthenic orthophoria, and sthenic and asthenic heterophoria. *The Ophth. Rec.*, Jan., 1896.

The numerous papers by JAVAL (61) on squint and binocular vision, published in various places, have been collected, and to them have been added a great number of carefully prepared case-histories, in making up the hand-book. The nosographical part contains many valuable original observations. In his theoretical explanation of squint, Javal goes back 150 years. He believes, as did Buffon, that squint is a primary anomaly of binocular vision, and not a primary muscular anomaly. In this respect the author differs with the prominent representatives of modern ophthalmology. Nevertheless every one will recognize the logical presentation of his views, both as regards the theoretical conception and the therapy of squint. The present status of the question permits no definite conclusions in regard to the physiology

of binocular vision and to squint. An attempt in this direction is, however, the more praiseworthy when, as in Javal's book, it includes a wealth of observation and thought. SULZER.

PANAS (62) recognizes in the too great shortening of the indirect attachments of the muscle (Tenon's capsule and orbit) the insufficient results of tenotomy, and he endeavors to stretch these attachments more thoroughly. A squint-hook is passed beneath the tendon, and it is stretched laterally and forward in order to loosen the indirect attachments, and then the tendon is divided in the usual way. In most cases both eyes are operated together and in narcosis, the wounds being sutured with catgut. The author prefers this operation to tenotomy combined with unilateral advancement. Whether, with the added advantage of simplicity, this operation accomplishes as much as tenotomy and advancement, or the more usual bilateral tenotomy, cannot be decided with certainty from the small number of cases reported.
v. MITTELSTÄDT.

In STOEWER'S (64) patient, a man of forty-six, a left abducens paralysis followed an injury of the left temple. Since contracture of the internal rectus led to marked convergent strabismus, the internal rectus was tenotomized and the external rectus advanced. This was of only transient benefit and two years later the operation had to be repeated. Since the external rectus was very much atrophied, a portion of the subconjunctival tissue and of Tenon's capsule was removed with the overlying conjunctiva, and the wound sutured. The ball then turned but slightly inward.

SILEX (66) reports three cases of partial, isolated paresis of the orbicularis muscle occurring in women who were otherwise healthy.

It is not possible in a mere abstract of BULL'S (67) carefully prepared statistics to give more than the practical conclusions which he has drawn from a study of these cases. In alternating squint with little amblyopia and but little difference in the refraction of the two eyes, a free tenotomy of the eye which usually squints commonly suffices. If the same eye always squints and there is decided amblyopia with a difference in the refraction of the two eyes and no loss of power in the external rectus, the best results are obtained by a tenotomy of the internal rectus and an advancement of the external rectus of the squinting eye, with subsequent full correcting by glasses. If, however, there is considerable loss of power in the external rectus, he divides the internal and

advances the external, and later divides the internal rectus of the other eye. He advises against a division of the internal rectus of both eyes at the same time, except where the external rectus is entirely paralyzed, when an advancement of this muscle is to be simultaneously made. Any complication in the way of maculæ corneæ, striæ in the lens, or choroidal trouble demands a much more extensive operative interference with the muscles than uncomplicated cases. BURNETT.

The principal points in DE SCHWEINITZ's (68) case are: right oculomotor paralysis when one and a half years old with recovery in six weeks. Many attacks of neuralgia of a migraine character, associated with the same temporary oculomotor palsy, until her fourth year, when the divergence became stationary, the ptosis occurring occasionally as before. Finally at twenty-eight a permanent ptosis after a very violent attack of migraine; no other nerves affected. BURNETT.

OPPENHEIMER (69) believes that strychnia is a specific tonic of the interni, and relates the histories of twenty-seven cases in which relief of exophoria—generally, however, of very low degree, 1 to 4 prism-diopters—was obtained after using the drug for some time. No other therapeutics were addressed to the eyes themselves. BURNETT.

SAVAGE (70) makes an asthenic form of orthophoria in which all the muscles are weaker than normal, though there is no unbalance. This can be treated, when it gives rise to trouble, by systematic exercise with prisms or what he calls the "wall to wall" exercise, that is, moving the eyes systematically from side to side or up and down as far as possible. In the sthenic forms of heterophoria prism or other exercise is to be used when the stronger muscle does not exceed its normal strength; but when it does, then tenotomy is called for or a shortening of the weaker muscle. In the asthenic form an operation will in most instances do harm. The special indications for treating the different forms of heterophoria are set forth in the paper. BURNETT.

X.—ORBIT AND NEIGHBORING CAVITIES.

71. MITVALSKI. On orbital thrombo-phlebitis. *Arch. d'opht.* xvi., 1, p. 22.

72. FROMAGET. Cysticercus of the orbit. *Ibid.*, p. 6.

73. Silex. Traumatic pulsating exophthalmus. *Deutsche med. Wochenschr.*, 1896. *Vereinsbeilage*, p. 23.

74. Lawford. A case of hydatid cyst of the orbit; removal of cyst, with preservation of eye and vision. *Trans. Ophth. Soc. Un. K.*, xv., p. 167.

75. Lawson. Plastic cellulitis of orbit. *Ibid.*, p. 185.

76. De Schweinitz. Traumatic enophthalmus, with a case. *Trans. Amer. Ophth. Soc.*, 1895.

77. Fryer, B. E. Report of a case of trauma of left orbit in which exophthalmus and probably aneurism of the internal carotid artery in the cavernous sinus resulted; recovery from the aneurismal symptoms without operative interference. *Ibid.*

In Mitvalski's (71) first case there was a phlegmonous inflammation of the left tonsil, with involvement of the region of the parotid and jaw, followed on the seventeenth day by sudden blindness and exophthalmus of the right eye, and twenty-four hours later of the left. Six hours later the patient died from meningitis and septicæmia. In his second case an inflammatory exophthalmus developed on the left side, soon followed by symptoms of septic infection. Up to the time of death, six days later, some vision was preserved. The origin of the primary thrombo-phlebitis in these cases was not found, but it probably was in the skin of the lids. The development of exophthalmus of the eye opposite to the primary focus, which has been previously noticed, is explained by the author as being due to a circumscribed inflammation of the cavernous sinus extending forward and backward, but reaching the circular sinus more readily than the ophthalmic vein. This sinus, since it is very narrow, is easily thrombosed, and the conditions are then favorable to the further development of bacteria. From this focus of more intensely acting infection the sinus of the opposite side is affected. The freedom of the right eye from infection in the second case is explained by the author as being due to a clot of blood in the right cavernous sinus and extending into the ophthalmic vein. Microscopic examination showed that the thrombus, consisting of red blood corpuscles, contained no microbes and acted as a bar to the extension of the infection. The first symptom of the affection, the serous chemosis, cannot be explained solely by the thrombosis of the posterior venous trunks, for only when the anterior trunks are partially affected and the current through collateral veins is checked, does

serous chemosis develop and become increased by the phlegmonous inflammation of the orbital contents.

Ophthalmoscopically, there was thrombo-phlebitis of the central retinal vein in the first case; in the second, only signs of extreme congestion. Consequently there was blindness only in the first case, for this could not be caused by simple compression of the central vein in the orbit, but by the inflammation in the vein. The extension of the inflammatory process is more rapid in the narrow thin-walled veins, where the cocci increase readily in the white thrombi. The inflammation of the wall of the vein extends from the intima and the thrombus toward the adventitia, and the white thrombi arise less through increase in the number of white blood corpuscles than through inflammation of the wall of the vein. The vasæ vasorum, in the neighborhood of which were many extravasations of blood, were never thrombosed and were free from cocci. The extension of the inflammation directly or centripetally is much slower than that recurrently. In the latter, when the principal trunks are involved, all the distal veins are affected and the affection of the central veins causes blindness. In the centripetal form only a limited region is affected at first, and the joining veins are gradually affected later, so that a collateral circulation is possible and the central vein may remain free, as in the second case, in which there was vision in spite of excessive exophthalmus. In the first case the infection was with the Fraenkel-Weichselbaum diplococcus. This was found always in the interior of the veins and the inflammatory products, less frequently on the slight deposits on the inner walls of the larger veins, and particularly in the veins of small calibre, the white blood corpuscles, and the cell detritus. In the second case quantities of the staphylococcus aureus were found in the larger venous trunks, the purulent thromboses, and in the neighborhood of the destroyed venous wall and the neighboring orbital tissue. v. MITTELSTÄDT.

FROMAGET'S (72) case of cysticercus of the orbit was as follows: A tinsmith, aged thirty, complained of continuous pain about the orbit, with œdematous swelling of the upper lid, which latter was most pronounced toward evening and disappeared in the night. After a brief remission the symptoms reappeared, and a small tumor was found in the upper-inner angle of the orbit. When punctured, fluid escaped, but this was followed by the formation of a localized phlegmon of the orbit. When

punctured later, no fluid was obtained. A fibrous tumor the size of a date was removed from beneath the roof of the orbit, which contained a cysticercus vesicle of tænia solium and a pus cavity. This case was similar to the eight other cases previously reported. The patient is usually young, the tumor is beneath the nasal upper margin of the orbit and there is more frequently pain in the early stages; later there come on attacks of orbital phlegmon. and a fibrous tumor, fluctuating or hard, containing the cysticercus develops rapidly. While hydatid cysts grow slowly toward the cranial cavity, cysticercus always grows out of the orbit. It is chiefly dangerous because it causes phlegmon.

V. MITTELSTÄDT.

SILEX (73) report a case of pulsating exophthalmus in which ligation of the common carotid was followed by a return of the trouble.

LAWFORD'S (74) patient, a girl æt. seventeen, suffered from gradual proptosis downward and outward, limitation of movement up and in; optic neuritis with hemorrhages. Soft mass felt in orbit; no fluctuation. Patient never out of England. No dogs in house. Operation: cyst removed entire, after evacuation; rapid recovery. Fluid contained large percentage of chlorides and trace of albumen; walls laminated; no hooklets. An analysis of 46 recorded cases is given. WERNER.

LAWSON (75) records five cases of orbital cellulitis with fibrinous exudation; in only one was there a little pus; three of the patients died, one had the eye removed, and one recovered with impaired vision. No history of injury, or syphilis. One case was preceded by acute tonsillitis, and in another there was pyæmia preceding it. Mr. Hulke thought that thrombosis of the cavernous sinus probably preceded the orbital cellulitis in septicæmic cases.

WERNER.

DE SCHWEINITZ'S (76) case was a man of twenty-three who received a very severe injury by being struck by a trolley car. Both eyes were swollen shut, and when he could open them it was found that the left had receded into the orbit 4 *mm* deeper than its fellow. There was also limited movement up and in and up and out, while the downward motion was somewhat in excess of that of the right. There was crossed diplopia in all parts of the field of fixation. The author thinks the enophthalmus in this case due to lesion of the sympathetic, as there is no evidence of injury to the orbital walls. BURNETT.

In the case reported by FRYER (77) the injury to the orbit was inflicted with the sharp end of a broken umbrella rib. The exophthalmus was immediate and marked. The bruit was most distinctly heard on the left temple—the side of the injury. In a few months this had disappeared, and there was only a slight exophthalmus. The eye was turned in, but the vertical motions were normal. V was reduced to counting fingers at twelve feet, though there was little change in the fundus beyond a slight pallor of the disc. The action of the pupil was always normal.

BURNETT.

XI.—CONJUNCTIVA, CORNEA, SCLERA, ANTERIOR CHAMBER.

78. VOSSIUS. Croupous conjunctivitis and its relations to diphtheria. *Samml. zwangl. Abhandl. aus dem Gebiete der Augenheilk.*, 1896, 1.

79. PETERS. On the relation of xerosis bacilli to diphtheria bacilli. *Niedenhein. Ges. f. Natur. u. Heilkunde*, 1896, May 18.

80. SCHANZ. The importance of the so-called xerosis bacillus in the diagnosis of diphtheria. *Berl. klin. Wochenschr.*, 1896, No. 12.

81. HERTEL. The use of antitoxin in ocular diphtheria and post-diphtheritic paralysis of accommodation. *Corr.-Bl. des Allgem. aerztl. Vereins von Thüringen*, 1896, No. 5.

82. AUBINEAU. On serotherapy in diphtheritic conjunctivitis. *Thèse de Paris*, 1896.

83. EWETZKI. On ocular diphtheria and serotherapy. *Wratsch*, 1896, Nos. 7–8.

84. AXENFELD. On a school epidemic of conjunctivitis caused by pneumococci. *Zeitschr. f. Schulgesundheitspflege*, 1896, No. 3.

85. EVERSBUSCH. Experiences in the treatment of chronic trachoma and its consequences. *Zehender's klin. Monatsbl.*, xxxiv., p. 1.

86. VILLARD. Pathological anatomy of granular conjunctivitis. Paris, 1896.

87. BURNETT, S. M. The influence of country and of race in the etiology of trachoma. *Ann. d'ocul.*, cxv., p. 114.

88. KAMOCKI. Amyloid degenerations of the conjunctiva. *Beiträge z. Augenheilk.*, xxii., p. 69.

89. Bayer. Vascular tumor of the conjunctiva. *Corr.-Bl. d. Ver. d. Aerzte von Reichenberg und Umgebung*, 1896, No. 1.

90. Ewetzki. Scleroma of the ocular conjunctiva. *Beiträge z. Augenheilk.*, xxii., p. 57. A description of two cases examined microscopically.

91. Lawford. Ophthalmia nodosa. *Trans. Ophth. Soc. Unit. Kingd.*, xv., p. 210.

92. Strause, A. N. Curettage in the treatment of trachoma. *Med. News*, Jan. 11, 1896.

93. May, C. H. Mixed forms of trachoma and spring catarrh. *Annals of Ophth. and Otol.*, Jan., 1896.

94. Beard, C. H. The treatment of trachoma and trachoma sequelæ. *Journ. Amer. Med. Assoc.*, Jan. 11, 1896.

95. Lippincott, J. A. Small cavernous angioma of the ocular conjunctiva. *Trans. Amer. Ophth. Soc.*, 1895.

Vossius (78) observed 22 cases of croupous conjunctivitis in children aged from nine months to eleven years. Of these, 13 suffered from eczema of the face and lids, and there were corneal complications in 9. On the ground of clinical observation and bacteriological examination he states that diphtheritic conjunctivitis may run its course either with an exudation into the tissue of the conjunctiva or a pseudo-membrane on its surface, and that the relation of the affection called croupous conjunctivitis to diphtheria can only be determined by bacteriological examination. Diphtheria of the conjunctiva may appear under the picture of croupous conjunctivitis, which was formerly considered a benign affection.

Peters (79) believes, if we accept the morphological and biological identity of the xerosis, pseudo-diphtheria, and diphtheria bacilli, that it is the varying virulency of this microbe that causes the difference in the clinical forms of conjunctival diphtheria.

Schanz (80) is also of the opinion that the xerosis bacillus is identical with the Loeffler bacillus, but of far less virulency.

Hertel (81) used antitoxin with success in three cases of severe diphtheritic conjunctivitis. The local treatment, however, cannot be neglected. Antitoxin seems to have no influence upon postdiphtheritic paralysis of accommodation.

Aubineau's (82) dissertation contains histories of two cases which prove the existence of diphtheritic conjunctivitis without a pseudo-membrane. The conjunctival affection in these cases

resembles catarrhal conjunctivitis, and bacteriological examination alone shows its true nature. The eight other cases were of conjunctivitis with pseudo-membranes caused by the Loeffler bacillus alone or in combination with the streptococcus or staphylococcus. Injections of antitoxin cause the pseudo-membranes to disappear in 24–40 hours. The diphtheria bacillus may be found several days after the subsidence of the clinical symptoms, but inoculations into guinea-pigs have no effect, as its virulence is greatly lessened by the injections. SULZER.

From his own study of two cases and the investigations of Uhthoff, Sourdille, Morax, and Schirmer, EWETZKI (83) has come to the conclusion that conjunctival croup and conjunctival diphtheria are identical. In one of his cases the Loeffler bacillus was found, in the other cocci as well as the bacillus. The first had more the character of croup, the second that of diphtheria. Both cases recovered entirely after two injections of antitoxin. The local treatment consisted only in the use of bichloride. Ewetzki would therefore describe the two forms as superficial and deep diphtheria of the conjunctiva. The difference in the character and development of the clinical picture depends probably on the varying degree of virulence of the bacilli (Martin), on mixed infection, on individual susceptibility, and on local conditions.

HIRSCHMANN.

In the treatment of trachoma EVERSBUSCH (85) has given up all operative treatment except canthoplasty when there is shortening of the palpebral fissure or entropium. He drops 5 per cent. solution of nitrate of silver on the granulated surface, sparing the rest of the conjunctiva, and repeats this every 5–8 days. Later the conjunctiva is massaged with yellow salve. The length of treatment is 1–2 months on the average. In obstinate cases of pannus he touches the conjunctiva 2–3 *mm* from the corneal margin with tincture of iodine.

VILLARD'S (86) conclusions as to the pathology of trachoma are as follows: The characteristic lesion of trachoma, the granulation, lies in the adenoid layer of the conjunctiva just below the epithelium, which it pushes forward and changes to pavement epithelium, and its intercellular spaces become filled with leucocytes. The epithelium between the granulations has more mucous cells than the normal. In old cases the epithelium is transformed into a many-layered pavement epithelium like that of the lips and vagina. The blood-vessels of the granulations

are quite normal. The polynuclear giant cells differ from those of tubercle. In the rabbit's conjunctiva there are granulations identical with those found in man, and here the lymph vessels open directly in the follicles. SULZER.

In BURNETT'S (87) paper on the etiology of trachoma Van Millingen's article is subjected to a critical revision. Burnett rightly remarks that statistical investigations on trachoma have the fundamental disadvantage that different authors call different conditions trachoma. His paper contains a number of interesting facts, which, contrary to Millingen's conclusions, show that both race and climate have a marked influence on the frequency of trachoma. SULZER.

KAMOCKI (88) questions the identity of hyalin and amyloid degenerations, and considers them different processes.

BAYER (89) reports two cases of true angioma of the conjunctiva seen in young girls. In both the tumor was noticed immediately after birth. Excision and suturing was successful in both.

LAWFORD'S (91) patient had a caterpillar thrown at him, which struck him in the eye. Symptoms: great photophobia, general congestion, papular elevations on conjunctiva. Cornea clear, iris healthy. In two of the conjunctival nodules were seen minute black points. The irritable condition of the eye lasted on and off for five months. The caterpillar was the Bombyx rubi. Two hairs were removed from the conjunctiva. A very full account of the cases already recorded is given with remarks on the hairs of caterpillars. The paper concludes with abstracts of recorded cases. WERNER.

STRAUSE (92) uses a sharp curette shaped like a cataract spoon for curetting the trachoma granulations. He thinks in this manner less violence is done to the normal conjunctival tissue than by either expression or grattage. The curetting can be done under cocaine, beginning first on the lower lid, then the retrotarsal folds, and lastly the inside of the upper lid, all of course under aseptic conditions. BURNETT.

MAY (93) thinks that spring catarrh may be complicated with trachoma as evidenced by the existence of pannus and cicatricial changes in the lids. The treatment of the trachoma he considers has a good effect on the spring catarrh. BURNETT.

No new methods are suggested by BEARD (94), but some slight modifications of old ones, as, for instance, in the operation for

entropion he makes a canthoplasty, then a Hotz operation, and fills in the open wound at the tarsal edge with mucous membrane from the lips. He commends expression of the trachoma granules.

BURNETT.

In the case related by LIPPINCOTT (95) a tumor the size of a large grain of wheat was situated 2 *mm* below the corneal margin. This tumor had made its appearance six years before in a woman of twenty-five years. It increased slowly in size, and there was at the time Lippincott saw her severe ecchymosis of the conjunctiva. The tumor was removed and examined by Prof. Whitney of Harvard, who pronounced it typical cavernous angioma.

BURNETT.

96. SACHSALBER. A contribution to the therapy of serpent ulcer. *Beiträge z. Augenheilk.*, xxii., p. 85.

97. UHTHOFF and AXENFELD. A contribution to the pathological anatomy and bacteriology of purulent keratitis in man. *Graefe's Archiv*, xliv., 1.

98. v. SICHERER. Comparative investigations in regard to various therapeutic measures causing leucocytosis in the treatment of staphylococcus ulcers of the cornea. *Arch. f. Augenheilk.*, xxxiii., p. 279.

99. SCHIRMER. A case of fungus keratitis. *Graefe's Archiv*, xliv., 1, p. 131.

100. STRAUBE. The treatment of corneal injection. *Geneeskundige Bladen*, 1896, iii., 3.

101. WEHRLE. The treatment of hypopyon keratitis in the Basle eye clinic. *Inaug.-Dissert.*, Basle, 1896.

102. v. HIPPEL, E. On parenchymatous keratitis. *Graefe's Archiv*, xlii., 2, p. 194.

103. MONREAL. On filamentous keratitis. *Inaug.-Dissert.*, Giessen, 1895.

104. VOSSIUS. On filamentous keratitis. *Deutsche med. Wochenschr.*, 1896, No. 29, p. 91.

105. BACH. Tuberculosis of the cornea. *Arch. f Augenh.*, xxxii., p. 149.

106. VAN DUYSE. Disturbance of vision in an eye with a corneal opacity. *Arch. d'opht.*, xvi., 1, p. 65.

107. CHWALYNSKI. On the transplantation of the cornea. *Wjest. Ophth.*, 1896, No. 2.

108. SNELLEN. The treatment of keratoconus. *Nederlandsche Oogheelkundige Bydragen*, i., p. 13, 1896.

109. NOYES. Traumatic keratitis caused by forceps delivery of an infant. *Trans. Amer. Ophth. Soc.*, 1895.

110. WOODS, HIRAM. Treatment of advancing corneal lesions in gonorrhœal ophthalmia. *Baltimore Presbyterian Eye, Ear, and Throat Charity Hospital Report*, Jan , 1896.

111. DUNN, JAMES W. A new method of examining the cornea. *Ophth. Record*, Feb., 1896.

112. RANDOLPH, R. L. A clinical and experimental study of the so-called oyster-shucker's keratitis. *Johns Hopkins Hospital Bulletin*, No. 56–57, and *Trans. Amer. Ophth. Soc.*, 1895.

According to SACHSALBER (96) every form of treatment of serpent ulcer that keeps the anterior chamber empty for any length of time may induce glaucoma, and for this reason he criticises Saemisch's operation when the wound is often opened.

Cauterization of the centre of an ulcer that might cause perforation is to be avoided, the infiltrated margins being cauterized to prevent extension.

In the first part of their paper, UHTHOFF and AXENFELD (97) describe the pathological changes in the various sorts of purulent keratitis in man. In the second part is described the bacteriological study of 50 cases of purulent keratitis, in 26 of which the Fraenkel-Weichselbaum diplococcus was found. In 7 cases (5 being serpent ulcer) pneumococci were found together with other microbes ; in 13 cases (4 being serpent ulcer) no pneumococci were found, but other microbes were present. In 4 cases the bacteriological examination was negative.

In the treatment of corneal ulcer v. SICHERER (98) first frees the conjunctival sac from secretion. The patient is directed to open and shut the lids frequently in order to wash away the bacteria with the tears. The eye is atropinized, yellow salve is put into the conjunctival sac, and an occlusive bandage is applied. Cauterization is done only when there is a tendency to extension. The favorable influence that the yellow salve and subconjunctival injections have on corneal processes depends principally upon the induced leucocytosis. The most preferable fluid for subconjunctival injection is salt solution.

In SCHIRMER'S (99) case an eyeball previously blind from trauma was enucleated for an ulcer of the cornea. In the centre

of the ulcer the cornea was pervaded with the thickly grown mycelium of a variety of aspergillus which extended anteriorly nearly to the surface of the cornea and posteriorly to Descemet's membrane.

Hypopyon keratitis, as WEHRLE (101) explains, is a spreading corneal ulcer usually due to injury with simultaneous infection. It has a deep overhanging margin where it is spreading and it is complicated with a collection of pus in the anterior chamber. Every method of treatment is contra-indicated that seeks to affect the ulcer at the cost of corneal substance, and particularly the actual cautery. Conservative methods give better results. He recommends linear cauterization and subconjunctival injections of bichloride or salt solutions, preferably the latter.

According to v. HIPPEL (102) there is no great difference between primary and secondary parenchymatous keratitis. It is usually, even when apparently primary, accompanied by or is the result of uveal inflammation. Hutchinson's teeth are not found in the majority of cases. Hereditary syphilis is the most frequent cause, but the tubercular diathesis, as well as rheumatism and malaria is of etiological importance.

MONREAL (103) records seventy-six cases of filamentous keratitis seen in the Giessen clinic. Most cases were in young individuals and in almost all there had been injury of the cornea, operative or otherwise, or superficial inflammation that led to changes in the epithelium. Recurrence was frequent. The appearance of the threads was constantly preceded by a burning or pressing pain; there was slight hyperæmia of the conjunctiva, lids, and retrotarsal folds, and a peculiar frothy, fibrinous secretion. The length and thickness of the filaments were variable. A basal cone of epithelium continued in a filament composed of fibrils wound together as in a rope and with its distal end ravelled out. The eruption of the filaments was always preceded by the appearance of little epithelial elevations or vesicles.

VOSSIUS (104) records four cases of filamentous keratitis.

According to BACH (105), tuberculosis of the cornea may appear under the typical picture of keratitis parenchymatosa. This affection is preceded without exception by the formation of tuberculous nodules in the ligamentum pectinatum. Tuberculosis of the cornea may also appear in the clinical picture of sclerosing keratitis. The cornea may also be affected by direct extension from tuberculosis of the conjunctiva.

Van Duyse (106), after repeating Hirschberg's experiment of photographing with a clear and with a partially cloudy objective, also agrees with him in tatooing corneal opacities rather than making an iridectomy that further obscures the sight.

v. Mittelstädt.

Chwalynski (107), together with Schimarowski did a number of corneal transplantations in animals with and without conjunctival flaps, and the transplanted piece became opaque in all. The authors conclude that the operation has no practical value and that nothing should be expected of it in the future.

Hirschmann.

Snellen (108) has seen but little result from excision, cauterization, or sclerotomy in cases of keratoconus. Hyperbolic lenses or stenopaic diaphragms permit vision in one direction only. A stenopaic slit, which cut off the diffuse rays but allowed a sufficiently large field of vision, gave better results. He therefore had made a horizontal slit for each eye, wide at the left end and gradually coming to a point at the right. With this arrangement an entire line can be seen diffusely, but the word seen through the slit near its pointed extremity is sharply defined.

Westhoff.

In Noyes's (109) case, an infant delivered by forceps, in which there was much contusion of the scalp and pressure on the head, had a dense keratitis of the left eye, involving all the layers of the cornea. There was no history of syphilis. Under atropine the trouble disappeared gradually. Burnett.

Woods (110) has tried cauterization of the corneal ulcer accompanying purulent conjunctivitis with nitrate of silver in two cases, and with, he thinks, excellent results. He uses a solution 30 grains to the ounce. Burnett.

Dunn (111) shows that it is possible to utilize the reflection from the posterior surface of the crystalline lens for the purpose of examining the condition of the cornea as to the presence of foreign bodies, opacities, etc. This is done by bringing the eye of the observer to within an inch or less of the observed cornea close to the outer canthus, and moving it back and forth until it catches the rays emergent from the concave posterior surface of the lens. Burnett.

Randolph (112) after a case for experimental study of oyster-shucker's keratitis, and the effects of the oyster shell on the cornea of animals, has arrived at the conclusion that there is no

microbic infection, but that the inflammation is caused entirely by the mechanical irritation of the lime in the shell.

BURNETT.

Sections XII.–XXI. Reviewed by DR. P. SILEX.

XII.—IRIS.

113. WALTER. On sarcoma of the ciliary body. *Arch. f. Augenheilk.*, xxxii., 2, p. 106.

114. REDDINGIUS. Tremulous iris with extreme accommodation. *Nederlandsche Oogheelkundige Bydragen*, i., p. 19, 1896.

115. STEPHENSON. The excretory origin of certain forms of iritis and cyclitis. *Lancet*, Feb. 29, 1896.

116. WOODS, HIRAM. A case of iridodialysis with operation. *Presbyterian Eye and Ear Charitable Hospital Reports*, Baltimore, 1886.

117. HANSELL. Two cases of tumor of the iris. *Trans. Amer. Ophth. Soc.*, 1895.

118. WALKER. Sarcoma of the iris. *Trans. Ophth. Soc. Un. K.*, xv., p. 184.

119. MARSHALL. Cystic sarcoma of the ciliary body. *Ibid.*, p. 180.

WALTER (113) records a case of melano-sarcoma of the ciliary body, in which the tumor produced iridodialysis.

In a patient of twenty-seven with myopia of 7 D and V = $\frac{5}{4}$, REDDINGIUS (114) found the following :

1. When the patient fixes an object moved from side to side at his near point, there is iridodonesis in both eyes.

2. When he fixes an object at his far point, the symptom does not appear.

3. It is also wanting when he accommodates without making lateral movements of the eyes.

4. If homatropine has been dropped into one eye, the iridodonesis is seen only in the other. He concludes from this that with accommodation there is relaxation of the zonula.

STEPHENSON (115) applies Walsh's theory (that certain inflammatory affections, *e.g.*, of the skin, are due to the excretion of irritant substances circulating in the blood) to cases of cyclitis, in view of the fact that the ciliary body is a secreting organ. Cyclitis and

iritis are due generally to constitutional conditions, most of which are of bacterial origin. Micro-organisms have been found in iritis associated with typhoid fever, erysipelas, tubercle, and leprosy, while syphilis is most probably due to a micro-organism. Even in rheumatism there may be the same cause, as Ahlström has set up iritis in rabbits by inoculation of the anterior chamber with a piece of iris from a case of rheumatic iritis. Relapsing forms of iritis have been attributed by some to auto-intoxication.

WERNER.

In WOODS's (116) case the detachment of the iris, resulting from a blow, was from the upper half of its ciliary attachment, the detached portion stretching itself as a blue band across the pupil below the centre. An incision was made at the sclero-corneal margin above, and the detached part of the iris drawn into it. It retained its place, and the eye now looks as if under full mydriasis. $V = \frac{20}{10}$.

BURNETT.

The first of HANSELL'S (117) cases was a cyst of the iris, following a penetrating injury to the eye, associated with a traumatic cataract. The tumor was the size of a large pea, round, white, and glistening. The cyst, which was removed whole through a corneal incision, was found to contain a yellow glutinous substance. The other tumor was small, oval, non-vascular, and brownish in color, springing from the anterior surface of the iris. Dr. Loeb describes the tumor as a small fibroma, in a state of inflammation, and not a malignant growth nor tubercular.

BURNETT.

XIII.—CHOROID.

120. EWETZKI. On dissemination of sarcoma of the uveal tract. *Graefe's Archiv*, xlii., 1, p. 170.

121. KRAWTSCHENKO. A case of coloboma of the macula lutea. *Wjest. Ophth.*, 1896, No. 1.

122. PFLUEGER. Enucleation and exenteration. *Correspondenzbl. f. Schweizer Aerzte*, 1896, No. 1.

123. STOCKER. On the enucleation of eyes with panophthalmitis. *Ibid.*

124. HODGES, F. H., and RIDLEY, N. C. Intraocular melanotic sarcoma, with peculiar characteristics. *Trans. Ophth. Soc. Un. K.*, xv., p. 178.

125. BULLER. Sarcoma of the choroid. *Trans. Amer. Ophth. Soc.*, 1895.

EWETZKI (120) gives a clinical and anatomical description of (1) a case of melanoma of the iris extending to the ciliary body and choroid. It is interesting because the case was one of sarcoma springing from the posterior surface of the iris, and, further, because it showed the possibility of the dissemination of sarcoma elements to distant parts. The cells leave the tumor, and by their own activity distribute themselves in the vitreous and the ocular tissues. (2) The author describes a flat melanotic myxosarcoma of the choroid.

KRAWTSCHENKO (121) seeks the cause of the development of coloboma in a local inflammation of the choroid after the closure of the fœtal cleft. A portion of the retina over the coloboma preserved its functions to some extent, and a retinal vessel passed over the coloboma. HIRSCHMANN.

In cases of threatened sympathetic inflammation PFLUEGER (122) considers enucleation the safest prophylactic means. In cases of panophthalmitis, evisceration is the least dangerous operation.

STOCKER (123) does not agree with Pflueger. He records forty-one cases of panophthalmitis in which enucleation had a successful issue. It seems to him to be safer than evisceration, and he therefore gives it the preference.

In this case (124) the growth had perforated the eyeball. The extra-ocular portion was pale, contained very little pigment, and was a typical round-celled sarcoma, while the intraocular portion was deeply pigmented and presented the usual appearances. WERNER.

BULLER'S (125) case of sarcoma of the choroid, in a man of thirty-five, was seen very early in its growth, on account of the interference it caused with central vision. It was situated between the optic disc and the macula, was clearly defined, with no detachment of the retina. Its elevation above the disc level was 6 diopters. In four months it had increased to 9 diopters. An examination by Dr. Adami showed it to be a typical melanotic sarcoma. BURNETT.

XIV.—GLAUCOMA.

126. AGABALOFF. A record of the cases of glaucoma in the university eye clinic in Kasan, between 1884 and 1894. *Wjest. Ophth.*, 1896, No. 1.

127. ABADIE. On sympathetic glaucoma. *Arch. d'opht.*, xvi., No. 2, p. 81.

128. SUTPHEN. Salicyclate of soda in glaucoma. *Trans. Amer. Ophth. Soc.*, 1895.

129. LIPPINCOTT. Sudden blindness in a previously impaired eye, coming on after removal of the other for absolute glaucoma. *Ibid.*

AGABALOFF (126) records 769 cases of glaucoma, 28 per cent. of the total number of patients. Forty per cent. were seen between fifty-five and sixty-five years; 181 were in men, and 119 in women. The glaucoma was absolute in 363 patients, 210 men and 153 women. It was unilateral in 208 cases, in 67 of which vision in the healthy eye was normal. From these figures the author believes himself justified in concluding that after fifty-five unilateral glaucoma is apt to remain unilateral. Iridectomy was done in 128 cases, and sclerotomy in 2, while in 2 cases the lens was removed also, once successfully, in the other case with severe hemorrhage. Enucleation was done five times for pain in absolute glaucoma.

Three weeks after an iridectomy had been done on an eye almost blind from glaucoma, the anterior chamber remaining obliterated, ABADIE (127) saw the same disease appear under the symptoms of iritis in the other eye that had previously been healthy. Since the glaucoma in the first eye was malignant, Abadie did enucleation. At first there was improvement and even apparent recovery, but the glaucomatous symptoms reappeared, and were then successfully treated with eserine and quinine and bromide of potassium. Abadie quotes two observations by Galezowski and Gosetti, who also saw enucleation act favorably upon glaucoma in the other eye. In Galezowski's case also there were symptoms of iritis, which Abadie believes characterize the picture of sympathetic glaucoma. V. MITTELSTÄDT.

SUTPHEN (128) has found the salicylate of soda a valuable remedy in relieving the pains of glaucoma when given in 15-grain doses every four hours, even where there is no rheumatic tendency, and relates one case where an acute attack of glaucoma was cured by the use of the remedy in conjunction with eserine.

BURNETT.

In the case reported by LIPPINCOTT (129), a man of sixty-five years had glaucoma absolutum in the right eye for which an enucleation was done under ether. The left eye had glaucoma also, but there was ability to count fingers at the temporal side; pupil about 4 *mm* and sluggish; disc excavated; T + 1. On awaking

from the anæsthetic the next morning, the vision in the left was entirely gone, though to all appearances the eye was in exactly the same condition as just prior to the operation. BURNETT.

XV.—SYMPATHETIC OPHTHALMIA.

130. BACH. Experimental studies and critical remarks on sympathetic ophthalmia. *Graefe's Archiv*, xlii., 1, p. 241.

131. BACH. Experimental investigations on the genesis of sympathetic ophthalmia. *Sitzungber. d. phys. med. Gesellsch. zu Würzburg*, No. 5, June 20, 1895.

132. BACH. Further remarks on sympathetic ophthalmia. *Ibid.*, No. 7, p. 103.

BACH (130–2) does not agree with Deutschmann in his views on sympathetic ophthalmia, and for years has been busied with experimental studies on this disease. He has found bacteriological errors in Deutschmann's papers, and has been unable to confirm the majority of his propositions. His results are as follows: Experiments with various microbes have shown that a transference in the sense of the migration theory does not take place. The examination of eyes removed for sympathetic ophthalmia was always negative. After resection of a portion of the optic nerve, communication is never secured between the intervaginal spaces of the peripheral and central portions of the nerve. If the migration theory were right, panophthalmitis should lead more frequently to sympathetic inflammation. The objection that the bacteria of sympathetic inflammation cannot be discovered by our present methods, lacks confirmation. The fact that the inflammation begins in the uveal tract cannot be denied, and the time when this inflammation begins does not accord with the migration theory. Sympathetic ophthalmia, if Deutschmann's ideas be correct, must always be complicated with meningitis. Bach believes in a neuritic inflammation, which in consequence of irritation of the ciliary nerves produces changes in the other eye, demonstrable chemically and with the microscope, which are the beginnings of the inflammation. There is no typical picture of sympathetic ophthalmia. The transference to the other eye follows through the ciliary nerves, directly through the nerves of the vessels in the circle of Willis, and indirectly through irradiation in the medulla oblongata.

XVI.—LENS.

133. HESS. On opacity of the lens in its relation to general diseases. *Sammlung zwangloser Abhandlungen aus dem Gebiete der Augenheilkunde*, edited by Prof. Vossius, vol. i., part 2, 1896.

134. STADTFELD. The changes in refraction following extraction of the lens. *Zehender's klin. Monatsbl.*, xxxiv., p. 81.

135. NOYES. Severe hemorrhage following cataract extraction. *Trans. Amer. Oph. Soc.*, 1895.

136. WILSON, F. M. A third table of 10,000 cataract extractions. *Ibid.*

137. WEEKS. Discission of the capsule after cataract extraction, with the presentation of a new instrument. *Ibid.*, 1895.

HESS (133) speaks of those varieties of cataract that are supposed to be dependent upon general constitutional diseases, and those that are dependent directly upon a local ocular affection which is a manifestation of some general disease. In the first group are senile, diabetic, congenital, ergotine, and naphthalin cataract. In the second are the posterior polar cataract of retinitis pigmentosa, the choroidal cataract, and complicated cataract after irido-cyclitis.

STADTFELD'S (134) computations, based on Tscherning's schematic eye, lead him to the conclusion that it is incorrect to believe that the optical value of the lens is increased in myopia. In an emmetrope we have after extraction a refraction of + 10.7 D, when the glass is 15 *mm* from the eye. In a myope of 5 D, + 7.8 D ; in a myope of 25. D, − 2.7 D. The change in refraction after extraction of the lens increases with the degree of myopia. With hyperopia of 7. D there is a resulting difference of 8. D, and with a myopia of 25. D, a difference of 22, without any change in the optical value of the lens, which is always about 16 D.

To the statistics of hemorrhage after cataract extraction NOYES (135) contributes the histories of five cases in four patients. Two had high degrees of M. He thinks that the hemorrhage comes from the ciliary processes or choroid, and may take place a few hours or several days after the operation. He also thinks that a contemporaneous iridectomy is much more likely to lead to such complication. BURNETT.

In the tabulated statistics of cataract extraction from various sources WILSON (136) finds the average loss in the 10,000 cases to be 7.16 per cent., but little, if any, better than it was before the practice of strict antisepsis in ophthalmology. BURNETT.

WEEKS (137) describes and figures a new knife-needle for cutting the capsule after cataract extraction. It is sickle-shaped, with its concave edge sharp. Its advantage over the straight knife-needle is that its cutting edge can always be at right angles to the plane of the capsule, thus diminishing the strain on the ciliary ligament and lessening the danger of detachment of the capsule. BURNETT.

XVII.—VITREOUS.

138. KAUPP. On spontaneous hemorrhage into the vitreous. *Inaug. Dissert.*, Freiburg, 1896.

139. MOLL. An artery in the vitreous, a pupillary membrane, and a network of dilated veins beneath the conjunctiva in the same eye. *Centralbl. f. prakt. Augenheilk.*, 1896, p. 75.

140. WACHTLER. A case of arterial loops in the vitreous of both eyes. *Wien. med. Wochenschr.*, No. 10, 1896.

141. STEINER. Persistence of Cloquet's canal and posterior polar cataract complicated with specific chorio-retinitis; depositions of pigment in the walls of the canal. *Ann. d'ocul.*, CXV., p. 41.

142. KIPP. A case of recurrent hemorrhage into the vitreous body in a youth. *Trans. Amer. Ophth. Soc.*, 1895.

143. FRIEDENWALD. A hemorrhage into the retina and vitreous due to visible disease of the retinal veins in young persons. *Centrabl. f. prakt. Augenheilk.*, 1896, p. 30.

WACHTLER'S (140) patient, a man of twenty-one, had a persistent hyaloid artery. The vascular loops did not arise from the central artery, but from an artery near the margin of the disc. It was probably congenital.

STEINER'S (141) patient, a Chinese, aged fifty, had a persistent Cloquet's canal with pigment in its walls and specific chorio-retinitis. The pigment could not have come from the pigment epithelium; and Steiner considered it hematogenous pigment arising from an obliterated vessel. SULZER.

In KIPP'S (142) case a boy of ten years had a sudden blindness of the right eye, due to extravasation of blood in the vitreous, which ended in formation of cicatricial bands, cataract, and total blindness. Fifteen months after this he had a hemorrhage in the other eye which rendered the fundus invisible; the other parts of the eye were nornal. Urine normal. Only the movement of objects seen. Gradual improvement took place so that, a year

after the attack, vision was $\frac{15}{18}$. No change in the fundus. Six years after the first attack he had another in the same eye, which also closed up with normal vision in the course of six months.

BURNETT.

In one of FRIEDENWALD's (143) cases the veins were enlarged and of varying calibre ; in the others they were varicose. Clinically there was nothing important, and the etiology was not clear, though the anæmia was held responsible. An interesting fact was that in one patient there were numerous new-formed vessels in the vitreous, due to stasis in the veins.

XVIII.—RETINAL AND FUNCTIONAL DISTURBANCES.

144. FUCHS. On two affections related to retinitis pigmentosa (retinitis punctata albescens and atrophia gyrata choroideæ et retinæ). *Arch. f. Augenheilk.*, xxxii., p. 111.

145. BARKAN. Two cases of complete blindness caused by male hysteria ; cure. *Trans. Soc. of German Physicians in San Francisco*, 1896.

146. REINER. On amblyopia caused by bisulphide of carbon. *Wiener klin. Wochenschr.*, 1895, No. 52.

147. PERGENS. Amaurosis and amblyopia after hematemesis. *Annals d'ocul.*, CXV., p. 5.

148. GOLDZIEHER. On bitemporal hemianopsia. *Budapester Gesellschaft der Aerzte.*, April 11, 1896.

149. SCHÖLER. On the operative treatment of detachment of the retina. *Zehender's klin. Monatsbl.*, xliv., p. 18.

150. PARINAUD. Treatment of detachment of the retina. *Soc. d'opht. de Paris*, Feb., 1896.

151. SIEGFRIED. The traumatic affections of the macula lutea. *Inaug. Dissert.*, Zurich, 1896.

152. NUEL. Alterations of the macula lutea ; macular or perifoveal œdema. *Arch. d'opht.*, xvi., 3, p. 145.

153. USSHER. Medullated nerve fibres of the human retina ; microscopical examination of three eyes. *Ophth. Rev.*, xv., p. 1.

154. CALLAN. Eye lesions in myxœdema. *Trans. Amer. Ophth. Soc.*, 1895.

155. HEYL. Albuminoid (?) deposit on the optic disc and retina. *Ibid.*

156. PATRICK. Hysterical blindness and pseudo-meningitis, with report of a case treated by hypnotism. *Journ. Amer. Med. Assoc.*, Feb. 8, 1896.

157. JOHNSON, W. B. Amblyopia ex anopsia. *Trans. Amer. Ophth. Soc.*, 1895.

158. DUNN. Partial detachment of the infero-nasal artery of the retina. These ARCHIVES, xxv., p. 106.

According to FUCHS (144) the designation retinitis punctata should be given to those cases only that have other characteristic features besides the white spots. These characteristics are: the development of the disease in youth and usually in several members of the family, frequent consanguinity, decreased central vision and marked concentric contraction of the field, and hemeralopia. Another type of chronic retinal degeneration with which he classes retinitis punctata and retinitis pigmentosa is atrophia gyrata choroideæ et retinæ. He has seen four cases. Three were sisters of consanguineous parents, and all were hemeralopic from early youth. The disc, which has an appearance similar to that seen in retinitis pigmentosa, is surrounded by a zone of normal-colored fundus. Outside this is an atrophic zone in which choroidal vessels are seen running on the white ground of the sclera. The atrophic zone is interrupted by small healthy fields, and it is studded with pigment masses which are larger toward the periphery.

In these two cases of hysteria in the male related by BARKAN (145), the blindness was bilateral and complete, with all the symptoms of hysterical amaurosis. The treatment was tonics and the constant current, and a complete cure followed in each case.

BURNETT.

REINER'S (146) patient was a man of twenty-nine, employed in vulcanizing rubber. There was decrease in central vision, due to a central scotoma, contraction of the visual field, later pallor of the temporal halves of the discs, and a number of nervous symptoms. There was complete recovery.

PERGENS (147) reports two new cases of amaurosis after hematemesis, and gives a *résumé* of the sixty-two cases previously published.

From the symptoms shown by his patient, GOLDZIEHER (148) diagnosed a tumor compressing the chiasm. The patient was a woman, aged forty-two, who had not had syphilis. In the right field the temporal half was wanting, and the nasal half was con-

tracted concentrically 15°. In the left field the temporal half and the upper portion of the nasal half were wanting. There was also a paracentral scotoma in each field. Ophthalmoscopically pallor of the discs. The symptoms were explained on the supposition of a tumor of the hypophysis compressing the crossed bundles in the chiasm, and also a portion of the lateral fibres. In another case there was presumably an aneurismal dilatation of an arterial twig in the middle line of the chiasm.

SCHÖLER (149) gives the following directions for the surgical treatment of detachment of the retina: 1. The point of incision, whether iodine is to be injected or not, should be as far as possible from the lens, in order not to increase the nutritive disturbances of the lens that usually already exist, and if increased soon lead to cataract. 2. A second operative procedure should not be undertaken until the tension is restored. 3. The vitreous, when it is not fluidified, must be spared as much as possible, since incisions in it lead to the formation of cord-like cicatrices which may prejudice the result. He gets no results with Deutschmann's injections of vitreous.

PARINAUD (150) records a number of cases of detachment of the retina, in which recovery was brought about by puncture of the sclera with a linear knife in the region of the detachment. From the discussion it was manifest that this mode of treatment has been followed by good results in a certain number of cases.

SULZER.

SIEGFRIED (151) states that the percentage of cases of traumatic macular disease in the Zurich clinic is 0.43. Under the designation "trauma" he includes those affections of the yellow spot which are due to mechanical or chemical influences. Most of the cases were due to the action of blunt force. In some of these no changes could be seen, in others there was for a time Berlin's cloudiness of the retina and later often pigment changes at the macula and marked disturbances of vision. Foreign bodies caused macular changes and poor vision in several cases, and in several there was a very small central scotoma produced by the direct rays of the sun.

In the continuation of his paper on the changes in the macula lutea, NUEL (152) describes œdema of the macular region which is usually inflammatory. The principal changes are always in Henle's layer where the fibres are forced apart by fluid. In an eye with extensive corneal suppuration and also in an injured

eye, the retina in the macular region was detached and drawn forward into the vitreous in the shape of a papilla at the apex of which was the macula. In another injured eye, besides partial detachment at the macula and œdema, there was beginning retinal suppuration. In an eye with ciliary staphyloma and retinitis pigmentosa the cones and the cone fibres of the fovea were normal, but in the macula both the cones and the rods were altered. Furthermore there was circumfoveal œdema. The gray stripes in the macular region seen in many cases of choroiditis and retinitis indicate œdema, and the remaining scotomata are probably due to retinal detachment. Nuel also describes the condition of a retina with embolism of the central artery, the circulation being carried on through a collateral vessel. The vascular supply of the various layers of the retina is described in detail. All the vascular layers of the retina were found to be altered, while the other layers, including the rods and cones, were normal except in the fovea. The red spot at the macula is, in Nuel's opinion, the ophthalmoscopic expression of a marked capillary injection of the macula. V. MITTELSTÄDT.

USSHER (153) examined three eyes with opaque nerve fibres, staining by Pal's and other methods. The optic nerve fibres lose their medullary sheath at the posterior part of the lamina cribrosa, with the exception of a small number which retain their sheath as far as the retina. Two forms of swellings were noticed on the medullated fibres in the retina, viz.: 1st. Dark homogeneous swellings, deeply stained, arising from thickening of the medullary sheath. 2d. Light homogeneous swellings of the axis cylinder or of some substance between it and the medullary sheath. In some of these swellings a band can be seen running through the centre. WERNER.

CALLAN (154) has observed four cases of myxœdema and in none were any lesions found in the fundus or elsewhere which should be associated with the disease as an effect. POWERS.

In HEYL'S (155) case, illustrated with a good drawing, in addition to the "drusen" bodies on the optic disc, there were white exudations in the retina lying underneath the nerve-fibre layer. He thinks this white exudation at one time extended over the whole retina and has been gradually absorbed. During four months' observation, the white masses still remaining were perceptibly lessened. This exudate he thought came from the choriocapillaris system. He thinks the material is albumen from the blood. Vision was R $\frac{20}{15}$, L $\frac{20}{25}$. BURNETT.

PATRICK's (156) patient was a Swedish servant girl of thirty, with pain in and above the eye, with tenderness on percussion over left side of head and face with general cutaneous hyperæsthesia; temperature, 100°; pulse, 120. Total blindness in both eyes, which had come on in forty-eight hours. There was deafness in the left ear only. There were also other symptoms which pointed to hysteria. She was treated by hypnotic suggestion and cured. BURNETT.

JOHNSON's (157) case was a girl of ten years, who, as the result of a fall on her left forehead, had a conjugate deviation of both eyes to the right. She was unable to turn the eyes to the left beyond the median line. Vision in each at that time was $\frac{20}{20}$. Ten years later she could carry the right eye inward to about the normal extent, but not the left eye outward, and the vision in the left had deteriorated to $\frac{20}{100}$, the right remaining $\frac{20}{20}$. The deterioration of vision in the left eye the author thinks is due to an active attempt to suppress the image in that eye in order to avoid diplopia, and that it is not central. BURNETT.

DUNN's (158) patient was a woman who had suffered from exudative choroiditis. In the vitreous was a white spot which was clearly seen with + 8 D. Behind it there was seen with + 5 D the infero-nasal artery of the retina, which was detached for a short distance and thrown forward in a curve into the vitreous, while the retina was everywhere in position.

XIX.—OPTIC NERVE.

159. ADLER. A case of foreign body in the disc. *Prager med. Wochenschr.*, 1895, No. 50.

160. FEILCHENFELD. On optic-nerve atrophy. *Inaug. Dissert.* Kiel, 1896.

161. CAMPBELL-HIGHET. Gonorrhœa as a cause of neuro-retinitis. *Annal. d'ocul.*, CXV., p. 47.

FEILCHENFELD (160) found 625 cases of optic-nerve atrophy among 38,000 patients in the Kiel eye clinic, and as to the etiology, 59 cases were following neuritis, 29 meningitis, 28 acute infectious diseases, 10 tabes, 3 multiple sclerosis, 4 nasal tumors, 5 hydrocephalus, 32 lues, 37 trauma, 41 alcoholism, 7 exposure to cold, 21 congenital, 3 cretinism. As rarer causes were enumerated: pregnancy 7, parturition 1, cessation of menses 7, embolism of central artery 4, diabetes 4, apoplexy 4, blindness from lightning 3, arsenic intoxication 2.

HIGHET's (161) patient, a healthy man of thirty, developed a bilateral neuro-retinitis three weeks after a severe gonorrhœic infection, which ended in recovery.

XX.—INJURIES, FOREIGN BODIES, PARASITES.

162. WEISZ. On magnet extraction. *Centralbl. f. prakt. Augenheilk.*, 1896, p. 5.

163. BOHMER. Extraction of foreign bodies from the posterior segment of the eye by means of the electro-magnet. *Annal. d'ocul.*, CXV., p. 161.

164. FRIEDENWALD, H. The removal of foreign bodies of iron or steel from the interior of the eye with the galvano-magnet, *Annals of Ophth. and Otol.*, January, 1896.

165. BARKAN. Six magnet operations for removal of fragments of iron from the eye. *Trans. Med. Soc. of California*, 1895.

166. HOLT. Report of eight cases of removal of metal from the vitreous by the electro-magnet, with a review of nine cases previously reported. *Trans. Amer. Ophth. Soc.*, 1895.

WEISZ (162) records a case of magnet extraction of a foreign body located above the disc and 2 *mm* from the retina.

After describing the successful extraction of a very small splinter of iron from the vitreous, BOHMER (163) adds an historical and critical exposition of the question of magnet extraction. He employs the electro-magnet of Charsin, the power of attraction for different distances and weights being accurately determined. With Hirschberg he prefers the small magnet, which is introduced directly into the wound, to the larger electro-magnets, which are placed in front of the eye. SULZER.

A synopsis of FRIEDENWALD's (164) cases are as follows: 1. Removal of a chip of steel embedded in the iris and capsule of the lens. 2. Removal of a small chip of steel from the macular region with a magnet; loss of central vision and detachment of the retina; preservation of the eyeball and eccentric vision. 3. Removal of a chip of steel embedded in the ciliary body and periphery of the retina; result, perfect vision. BURNETT.

A summary of BARKAN's (165) cases is as follows: 1. Unsuccessful removal of piece of steel 3 *mm* long, 2 *mm* wide, and 16½ milligrams in weight, from the interior of the eye; enucleation.

2. Unsuccessful attempt of removal of a piece of steel encysted in the rear of the eye eight weeks after injury; enucleation. 3. A piece of steel 3½ *mm* long, 1 *mm* wide, 3 milligrams in weight, successfully removed from the vitreous body with electro-magnet; recovery. 4. A piece of steel 2 *mm* long, 42 *mm* wide, and ¾ milligram in weight, successfully removed with magnet and forceps from the anterior chamber; recovery. 5. A small particle of steel 1 *mm* long, ½ *mm* wide, ½ milligram in weight, removed from the vitreous body by the magnet; recovery. 6. A particle of steel 2 *mm* long, 1 *mm* broad, and 1 milligram in weight removed from the vitreous body by the electro-magnet; recovery. BURNETT.

Of the 17 cases in all that HOLT (166) has used the magnet for extraction of metal from the vitreous chamber, 6 eyes were lost and had to be enucleated. Of the others, 1 had V = 0.7; 3 V = 0.5; 2 V = 0.2; 4 V = 0.1, and 1 quantitative perception of light. BURNETT.

XXI.—OCULAR AFFECTIONS WITH GENERAL DISEASES.

167. HEDDAEUS. Haab's "cortex pupillary reflex" in its relations to hemianopic pupillary reaction. *Arch. f. Augenheilk.*, xxii., ii., p. 89.

168. BESELIN and NONNE. On contracture and paralysis of the intrinsic and extrinsic ocular muscles in hysteria. *Festschrift z. Feier d. 80. Stiftungsfestes d. V. zu Hamburg*, 1896.

169. SILEX. Pathognomonic signs of congenital syphilis. *Berl. kl. Wochenschr.*, 1896, No. 7.

170. EVERSBUSCH. Treatment of ocular disturbances due to kidney diseases. *Handbuch d. spec. Therapie innerer Krankheiten*, vol. vi. Edited by Pentzold and Stintzing.

171. EVERSBUSCH. Treatment of ocular disturbances due to diseases of the organs of respiration and circulation. *Ibid.*, vol. iii.

172. EVERSBUSCH. Treatment of toxic ocular affections. *Ibid.*

173. STEINLECHNER. On the simultaneous existence of Basedow's disease and tetanus. *Wiener klin. Wochenschr.*, 1896, No. 1.

174. JACOBSON. An unusual case of lesion of the cervical sympathetic. *Centralb. f. Neurologie*, 1896, p. 195.

175. BOEDEKER. The pathological condition found in a case of chronic nuclear paralysis of the ocular muscles. (A contribution to the location of the nucleus of the fourth nerve.) *Arch. f. Psych. u. Nervenkrankheiten.*, xxviii., p. 243.

176. URBANTSCHITSCH. The reflex influence of the ear on the oculo-motor apparatus. *Wien. kl. Wochenschr.*, 1896, No. 1, p. 1.

177. NORMANN, HANSEN. A shot injury of the orbit. *Centralbl. f. prakt. Augenh.*, 1896, p. 76.

178. FISCHER. On Biermer's essential anæmia, and pseudo-essential anæmia due to worms. *Ibid.*, p. 81.

179. GUTMANN. Paralysis of accommodation and antitoxin. *Inaug. Dissert.*, Berlin, 1896.

180. KATZ. On the simultaneous existence of optic neuritis and acute myelitis. *Graefe's Archiv*, xlii., p. 202.

181. SEYDEL. Operative removal of an intracranial tumor. *Centralbl. f. Chirurgie*, 1896, No. 13.

182. RING, G. ORAM, and MILLER, J. M. A case of acute lead-encephalopathy with interesting ocular manifestations. *Amer. Journ. Med. Sciences*, Feb., 1896.

183. RISLEY. A case of vaso-motor ataxia with eye symptoms simulating monocular exophthalmic goitre. *Trans. Amer. Ophth. Soc.*, 1895.

HEDDAEUS (167) does not consider Haab's cortical pupillary reflex as an actual cortical reflex, but he believes that the patient who has fixed for some time, tires, and relaxes his accommodation, and with the relaxation the pupil dilates. If now a sensory optical or acoustic irritation acts, the accommodation is exercised, the pupils become smaller, the image of the candle flame falls on a less fatigued spot in the retina, and the visual sphere is stimulated. The irritation of the retina following the act of accommodation affects not only the visual fibres, but also the centripetal pupillary fibres, and the pupil contracts. In testing for the so-called hemianopic pupillary reaction, one should notice whether the Haab attention reflex is present, this always appearing when a seeing portion of the retina is stimulated by light, and this stimulation leads to the act of accommodation. The patient should be made to fix a test letter 2 *m* distant in a dark room and not allow his attention to be diverted by two flames of equal intensity one to his right and one to his left. The lights are shaded alternately in order to find whether the width of the pupil remains the same.

BESELIN and NONNE (168) discuss very thoroughly the unsettled subject of ocular-muscle paralyses in hysteria, and conclude that

in many of the cases of apparent paralysis of extrinsic muscles, the real lesion is a contracture of the antagonist muscle. An internal ophthalmoplegia may be paralytic.

SILEX (169) in the conclusion of his paper states that there are three pathognomonic signs of congenital [hereditary? Ed.] syphilis: (1) choroiditis areolaris; (2) Hutchinson's teeth; (3) scars on the lips and elsewhere in the face. Silex reviews the opinions of ophthalmologists in regard to the significance of Hutchinson's teeth. Microscopic examination of the scars on the face have shown him that these have not the characteristics of true scars, and he calls them therefore pseudo-cicatrices.

EVERSBUSCH (170) speaks of the close relations between diseases of the nose and eye, and particularly the affections of the accessory sinuses.

EVERSBUSCH (172) discusses the toxic affections of the eye under the headings. 1. The intoxication amblyopias and fundus diseases. 2. The affections of the ocular muscles and nerves. 3. The affections of the lids and conjunctiva; and 4. The deleterious effects of medicaments of the eye.

STEINLECHNER'S (173) patient, a woman of twenty, who had been strumous since childhood, was attacked with tetanus, and after symptoms of Basedow's disease had occurred, died of nephritis. At the autopsy an encapsulated cysticercus was found in the cerebral cortex.

After the opening of a gland abscess on the left side of the neck in an infant of eighteen months, JACOBSON (174) saw contraction of the pupil, narrowing of the palpebral fissure, pallor and coldness of that half of the face, anidrosis, enophthalmus, and sinking in of the entire half of the face.

BOEDECKER'S (175) patient, a woman of forty-two, had had a complete left oculo-motor paralysis with amblyopia of the left eye twelve years before, and later optic-nerve atrophy in the same eye. The right eye was normal except for a pupil unresponsive to light or in convergence. At the autopsy there was found a degeneration of the periphery of the left oculo-motor nerve, and of the oculo-motor ganglion-cell nests, roots, and fibre bundles of both sides, but more marked on the right. The nucleus of the fourth nerve was intact, *i. e.*, the ganglion cells of the nucleus at the distal end of the group of oculo-motor nuclei projecting into the longitudinal bundle were of normal aspect as were also the intramedullary fourth-nerve fibres. The clinical and anatomical

conditions force him to the conclusion that the nucleus in the posterior longitudinal fascicle belongs to the fourth nerve.

URBANTSCHITSCH (176) states that the principal ocular reflex from aural disease is nystagmus, but occasionally spasm or paralysis is seen, and even affections of the intrinsic muscles.

A transient nystagmus may be excited from the outer, middle, or inner ear, from the auditory nerve trunk, and even by an acoustic excitation. These reflex ocular movements are explained by the connection which has been shown by experiments to exist between the semicircular canals and the innervation centre for the ocular muscles. The movement is generally brought about reflexly, but it may be produced by pressure, or irritation of the occipital lobes by abscess, or hyperæmia, and also by sinus thrombosis. Strabismus rarely occurs, and reflex pupillary symptoms are very uncommon, though Moor has described a case of paralysis of the fourth nerve from purulent otitis media.

FISCHER (178) speaks of the various intestinal parasites which bring about an anæmia that is mostly designated as essential anæmia but may resemble leucæmia. When such an anæmia is accompanied by retinal hemorrhages, intestinal worms should be thought of and male fern given.

Comparing sixteen cases of diphtheria, followed by paralysis of accommodation, treated with antitoxin, with thirty-five cases in which antitoxin was not used, GUTMANN (179) concludes that antitoxin has no influence on the duration of the paralysis.

KATZ's (180) case was one of spontaneous myelitis with inflammation of the optic nerve. From his own case and twenty-one cases collected from the literature, the author sketches the following clinical picture. A previously healthy individual suffers a rapid loss of sight in one or both eyes, with severe pain in the forehead of the affected side. There is optic neuritis ending often in atrophy. Vision may be entirely lost for some time and then gradually return. The myelitis affects mostly the lumbar or dorsal portion of the cord, and less frequently the cervical. The myelitis and the optic neuritis are no doubt due to the same cause, which is still unknown, since the pathological changes are the same in both. Syphilis seems to play no rôle.

SEYDEL (181) reports another case of successful operation for brain tumor. The patient, a man of forty-seven, had received a severe blow on the head fifteen years before, from which he slowly recovered. In 1895 there were attacks of giddiness,

apathy, paresis of the right arm and leg, and headache. R v = $\frac{1}{6}$ with atrophy of the nerve; L v = $\frac{2}{3}$ with choked disc; notwithstanding the use of mercury and iodide of potassium the vision was reduced to R v = $\frac{1}{3}$, L v = ability to count fingers. In the beginning of January, 1896, trephining over the fissure of Rolando revealed the presence of a hard fibroma as large as a cherry extending into the convolutions. Recovery normal. January 17th, R v = $\frac{5}{6}$, L v = fingers at 1 *m*. The choked disc in the left eye has disappeared. On March 6th the patient felt perfectly well.

The ophthalmic portion of this paper is by RING (182), and it concerns a case of acute lead poisoning, with marked cerebral symptoms, but with no other of the usual symptoms of lead toxæmia. The ocular symptoms were paresis of the right external rectus and a pronounced neuro-retinitis, with hemorrhages in both eyes with blindness, going on to atrophy of the nerve, and some choroidal changes. Final vision in R $\frac{20}{40}$, L fingers at two feet. The left is said to have been bad before. BURNETT.

RISLEY'S (183) patient was a woman of forty-two who had a moderate exophthalmus of the right side. There was some enlargement of the thyroid and marked tachycardia with rapid pulse and irregular cardiac rhythm. The author thinks such cases fall under the class of vaso-motor ataxia.

BURNETT.

BOOK NOTICES.

I. G. E. De Schweinitz. **Diseases of the Eye.** With 256 text illustrations and two colored plates. Second edition, thoroughly revised. Philadelphia, W. B. Saunders. 1896.

This text-book of 654 pages and a double-columned index of twenty-five pages has rapidly and deservedly found its way to professional favor. The gifted young author, who has established his scientific reputation by several original investigations, among which we chiefly mention his monograph on the toxic amblyopias, has spared no pains to hold his practical treatise in keeping with the progress of ophthalmological research and experience by submitting the first edition to a thorough revision. Several chapters, for instance that on the operations, have been re-written and enlarged, and the following new paragraphs have been inserted: Filamentous Keratitis, Blood-staining of the Cornea, Circinate Retinitis, Symmetrical Changes at the Macula Lutea in Idiotic Infants, Monocular Diplopia, Subconjunctival Injections of Germicides, Infiltration-Anæsthesia, Angioid Streaks in the Retina, The Use of the Ophthalmometer of Javal and Schiötz and the Tropometer of Stevens, etc. H. K.

II. E. Javal. **Manuel théorique et pratique du Strabisme.** With forty-four figures in the text, a colored plate, and a set of forty-eight cartoons. Paris, G. Masson, 1896.

This volume of 372 small-octavo pages, nicely and compactly printed on thin paper, bound in a flexible linen cover, is original. It contains in an easy style the history of the learned author's work and endeavor during more than thirty years, in a field of surpassing scientific interest and conspicuous practical importance, the *perfect cure of strabismus*, which means the removal of the deformity and the restoration of binocular vision. The author thinks that this high object is obtainable in all cases, even if the sight of one or both eyes is materially impaired. This can be done by long-continued optical exercises, among which the correction of any refractive

error, the non-perforated coquille before the good eye, and stereoscopic exercises form the most serviceable aids. The author does not, however, omit to assert repeatedly that the time, work, and patience necessary to accomplish this end are in the majority of cases much greater than the real benefit gained by the patient, or, as v. Gräfe said, the beneficiaries would not be worth it. He advises to perform an operation in most cases, in order to correct, more or less, the deformity, and to submit to the laborious optical treatment only the favorable cases—that is, such as are sufficiently intelligent and resolute to reward the physician's prolonged efforts by a gratifying result. In addition to the presentation of this practical object, the book contains a galaxy of most interesting and instructive reading matter, with fascinating historical essays and happy and refreshing discussions of incident physical and physiological subjects. H. K.

III. E. Jackson. **Skiascopy, and its Practical Application to the Study of Refraction.** Second edition. Philadelphia, The Edwards and Docker Co., 1896.

The second edition of this well written monograph on the illumination or shadow test is essentially a reprint of the first. which appeared in 1895. It contains 108 pages instead of 104, The author says: "The changes made in this edition, while numerous, are most of them slight, being chiefly alterations of phraseology intended to render the expression of the thought clearer. One new illustration has been added." The little treatise deserves its popularity. H. K.

IV. M. Ohlemann. **Augenærztliche Therapie. Ophthalmic Therapeutics, for Physicians and Students.** Wiesbaden, Bergmann, 1896. Price $0.75. This book, from a German, is a novelty, and a very useful one. The author, a young man of the Berlin school, has collected in a systematic treatise of 166 large-octavo pages the orthodox remedies and methods of treatment used in modern ophthalmology, not only in Germany but in all other civilized countries, including America. He says: "In the treatment of eye diseases three chief methods may be distinguished, an operative, an optical, and a medicamentous. The latter only shall be the object of the present work."

The general part of the book—5 chapters, 47 pages—contains the mechanical treatment (massage), thermic means (cold and warm applications, dressings), chemicals (antiseptics, astringents, alkaloids, narcotics, and anæsthesia), electricity, general treat-

ment (blood-letting). The special part—11 chapters, 110 pages —contains the treatment of the affections of the different parts of the eye, lids, lachrymal apparatus, conjunctiva, etc. An index of authors, and an index of subjects, including the numerous prescriptions, conclude the handsome little volume. The author has been an industrious compiler. The chief field of his gleanings was Hirschberg's *Centralblatt für practische Augenheilkunde.*

H. K.

V. O. Lubarsch and R. Ostertag. **Ergebnisse der Pathologie des Menschen u. der Thiere.**

Fourth Part. Special Pathological Morphology and Physiology of the Sense-Organs. Wiesbaden, Bergmann, 1896.

This enterprise is to be a large comprehensive yearly review of the progress of pathology of man and animals. The first (present) volume is intended to be an introduction of the whole subject and therefore includes the investigations of preceding years in order to present the modern scientific status of the different departments.

The pathology and pathological anatomy of the eye occupies 210 large octavo pages, and has been written by Theo. Axenfeld, A. E. Fick, and N. Uhthoff. The whole presentation goes deeply into detail, is eminently scientific, and as exhaustive as human industry can make it. An index of authors and subjects aids in the use of the work as a book of reference.

VI. E. Treacher Collins. **Researches into the Anatomy and Pathology of the Eye.** With 10 plates and 28 figures in the text. London, H. K. Lewis, 1896. This well gotten up, richly illustrated volume of 140 pages contains a considerable series of original investigations which the meritorious author made during the six years of his curatorship at the Royal London Ophthalmic Hospital (Moorfields). All the articles are valuable contributions to ophthalmology, and not a few are of prime importance, for instance those on the lens and its capsule; zonular cataract and its connection with rickets; formation of fibrous tissue in the vitreous; method of bleaching sections of the eye; his fundamental researches on the ciliary body, its glands; adenoma and carcinoma of the ciliary body; glioma of the retina not sarcoma; on glaucoma; the modus operandi and failure of iridectomy; cystoid cicatrix; con-

error, the non-perforated coquille before the good eye, and stereoscopic exercises form the most serviceable aids. The author does not, however, omit to assert repeatedly that the time, work, and patience necessary to accomplish this end are in the majority of cases much greater than the real benefit gained by the patient, or, as v. Gräfe said, the beneficiaries would not be worth it. He advises to perform an operation in most cases, in order to correct, more or less, the deformity, and to submit to the laborious optical treatment only the favorable cases—that is, such as are sufficiently intelligent and resolute to reward the physician's prolonged efforts by a gratifying result. In addition to the presentation of this practical object, the book contains a galaxy of most interesting and instructive reading matter, with fascinating historical essays and happy and refreshing discussions of incident physical and physiological subjects. H. K.

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cussion of the eye; rupture of the inner coats; blood-staining of the eye. These and many other subjects form an extended field of labor which the author has cultivated with unparalleled success. Every thinking and progressive oculist will be pleased to possess the work of Mr. Collins collected in so attractive a form. His researches are all more or less fundamental and have given, on both sides of the Atlantic, a mighty incentive for re-examination and discussion. H. K.

VII. A. E. FICK (Zurich). **Diseases of the Eye.** Translated by A. B. Hale (Chicago). With 158 illustrations, many of which are in colors. Philadelphia, P. Blackiston, Son, & Co., 1896. Price, $4.50.

This text-book of 488 octavo pages, well gotten up on heavy paper, is a careful presentation of orthodox modern ophthalmology. The illustrations are almost all borrowed. The translation is easy and correct, and may be recommended at the side, though not in preference of the original English and American text-books. H. K.

VIII. W. F. NORRIS and C. A. OLIVER. **System of Diseases of the Eye,** by American and European authors. Philadelphia, J. B. Lippincott Co., 1897.

The first volume, 670 pages, profusely illustrated, of this cyclopedia, which promises to be the standard book for study and reference in the English language, has just been received. At present we confine ourselves to announce its appearance, reserving a review for our next number. H. K.

MISCELLANEOUS NOTES.

Dr. TH. SACHS, oculist and Privatdocent in Innsbruck, is dead. He was the author of a number of very valuable papers, of which we specially mention one entitled: Anatomical and clinical contributions to the knowledge of central scotoma in affections of the optic nerve, in vol. xviii., p. 133, of these ARCHIVES.

Dr. MELLINGER has been appointed professor of ophthalmology in the University of Basel, to succeed Prof. SCHIESS-GEMUSEUS, resigned.

Dr. BJERRUM, has been appointed professor of ophthalmology, in ordinary, at the University of Copenhagen, in place of Prof. Hansen-Grut, resigned.

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(German Edition of these ARCHIVES).

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1. L. BACH (Würzburg). Antisepsis and Asepsis in Operations on the Eyeball. Bacteriological Study.

2. N. ANDOGSKY (St. Petersburg). Danger of Infection in Eye-Operations.

3. G. ABELSDORF (Berlin). Metastasis of carcinoma in the uveal tract of both eyes. (Three plates.)

4. Dr. GUILLERY (Cologne). The amblyopia of squinting eyes.

5. J. WOLFF (Cologne). Does consanguinity predispose to dangerous myopia.

6. W. ALBRAND (Berlin). Report of 295 extractions made in Schöler's clinic.

7. WERTHEIM SALOMONSON and WESTHOFF (Amsterdam). Case of paralysis of the trigeminus.

8. S. STEPHENSON (Harwell, Eng.). Opaque nerve fibres at some distance from the retina. (Chromo.)

9. WEISS and GOERLITZ (Heidelberg, Mannheim). Case of one-sided microphthalmus and coloboma of the optic nerve. (Chromo.)

10. SIEGRIST (Basel). Ciliary processes in the pupillary space. (Chromo.)

11. M. SACHS (Vienna). Analysis of the touch-experiment.

12. H. WOLFF (Berlin). Advancement of the tendon of the elevator muscle of the upper lid.

13. S. SCHULTZE (Frankfort o/O). Tuberculous iritis and parenchymatous keratitis. (Plate.)

14. L. BACH. The nerves of the eyelids in man.

15. L. BACH. The nerves of the cornea and sclera with Golgi–Cajal's method. (Plates.)

16. M. STRAUB (Amsterdam). Statistics of congenital amblyopia.

17. L. WEISS (Heidelberg). Glass plates for drawings.

18. HESS (Marburg). Pathogenesis of striped corneal opacities.

19. R. GREEFF (Berlin). The neuroglia cells in inflamed or degenerated optic nerves. (Illustrated.)

20. FR. SCHANTZ (Dresden). Etiology of membranous conjunctivitis.

21. R. GREEFF. Translations of No. 1 of vol. XXV. of the English Edition.

22 and 23. Controversy between SICHERER and WECKER.

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24. H. KRIENES (Breslau). Light and color sense in affections of the retina, choroid, and optic nerve.

25. M. MÜTZE (St. Louis, Mo.). Parenchymatous keratitis with transitory diminution of tension and size of eyeball.

26. M. MÜTZE (St. Louis, Mo.). Molluscum contagiosum of the eyelids. (Two plates.)

27. L. WEISS (Heidelberg). Transplantations of conjunctival flaps in defects of the cornea with prolapse of the iris. (Illustrated.)

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Fig. 1.

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Fig. 2.

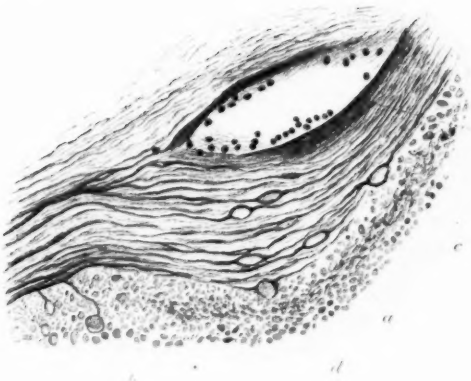

Fig. 3.

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R. A.

Fig. 1.

L. A.

Fig. 2.

Doppelseitiges Linsencolobom und linkseitiges Iriscolobom.

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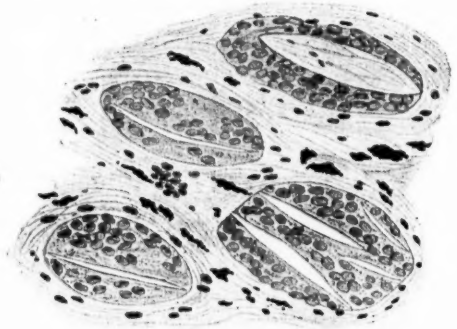

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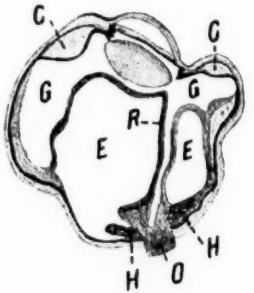
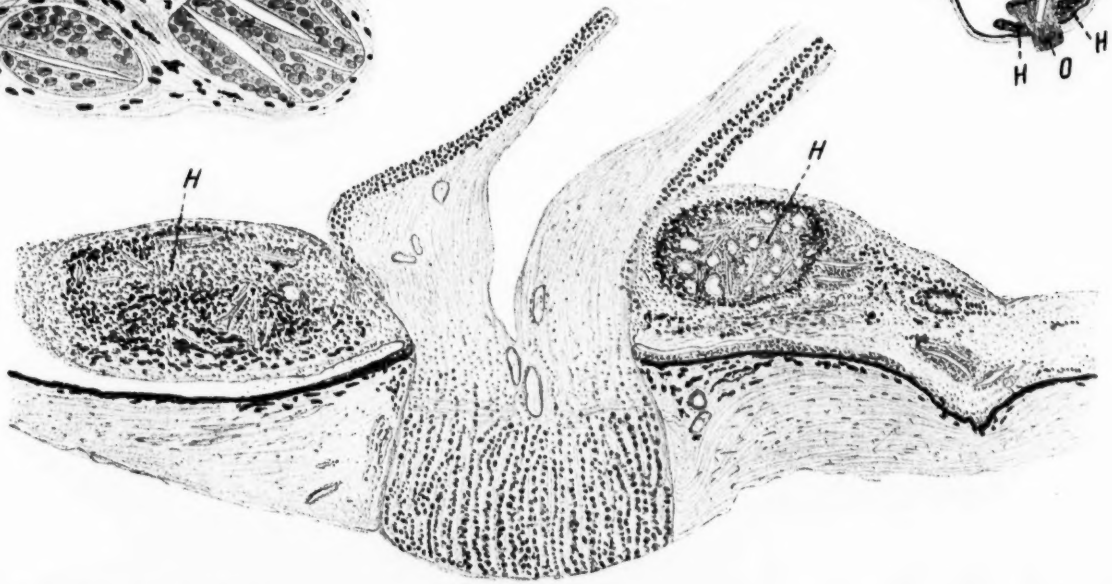


Fig. 1.

Fig. 2.



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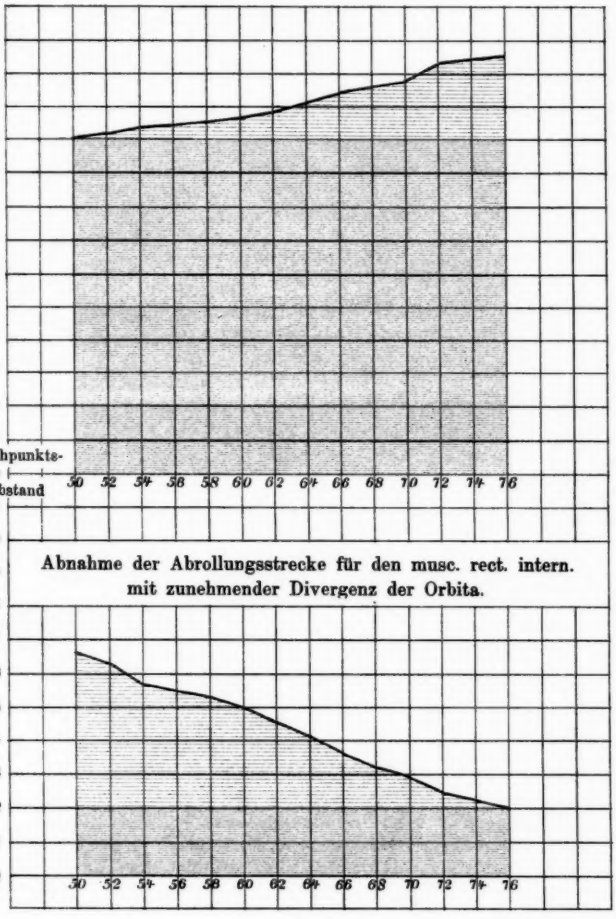
Zu Tabelle IV b 1.

ff = 30.

Abstand der foram. opt. orbital.

Directer Abstand der Drehpunktslinie von der Verbindungslinie der for. optic. orbital. = 30.

Zunahme der Abrollungsstrecke für den musc. rect. extern. mit zunehmender Divergenz der Orbita für das emmetropische Auge.


Grösse der Abrollungsstrecke für den musc. rect. extern.
Grösse der Abrollungsstrecke für den musc. rect. intern.
mit zunehmender Divergenz der Orbita.
Drehpunkts-abstand
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14
50 52 54 56 58 60 62 64 66 68 70 72 74 76
Abnahme der Abrollungsstrecke für den musc. rect. intern. mit zunehmender Divergenz der Orbita.
0 1 2 3 4 5 6 7 8 9 10 11
50 52 54 56 58 60 62 64 66 68 70 72 74 76
Pupillendistanz resp. Abstand der Drehpunkte.

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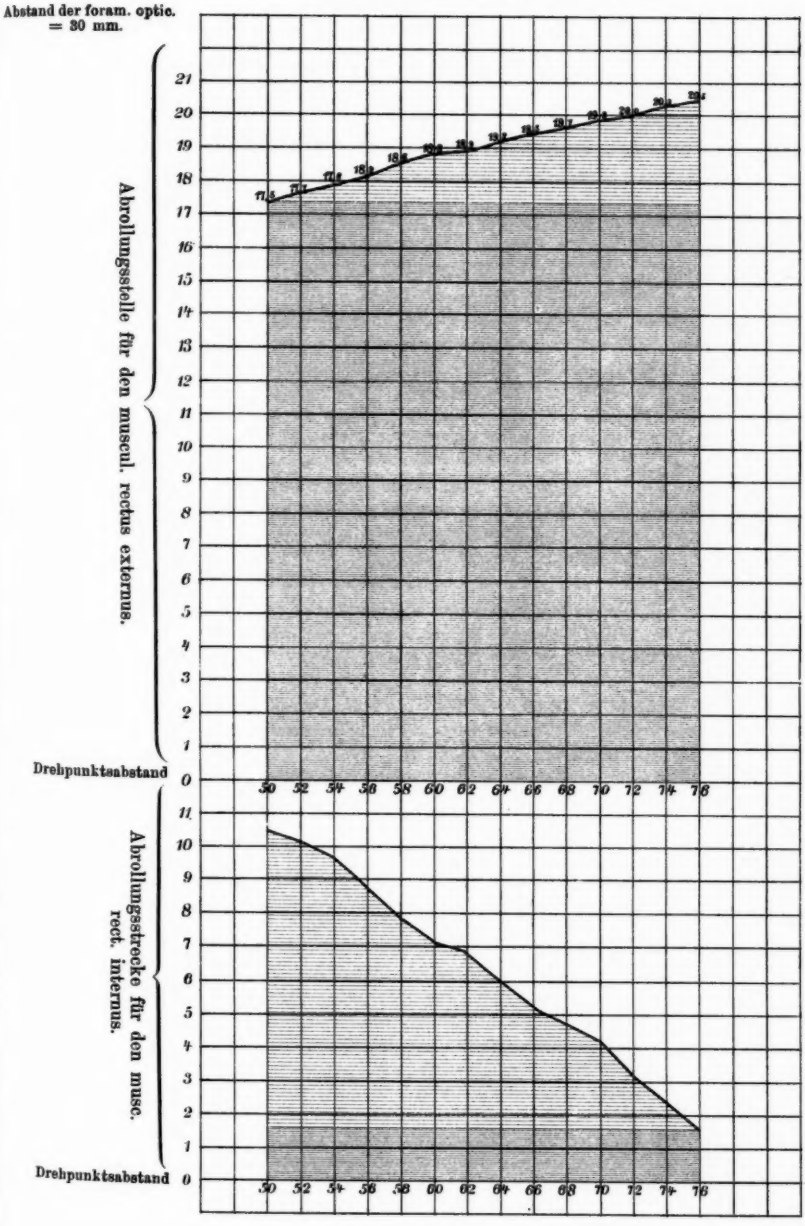
Zu Tabelle VII.

Für das hochgradig myopische Auge.


Abstand der Drehpunktslinie von der Verbindungslinie der foram. optic. = 27 mm.
Abstand der foram. optic. = 30 mm.
Abrollungsstelle für den muscul. rectus externus.
Drehpunktsabstand
Abrollungsstrecke für den musc. rect. internus.
Drehpunktsabstand
50 52 54 56 58 60 62 64 66 68 70 72 74 76

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Zu Tabelle VII.

Für das hochgradig hypermetropische Auge.

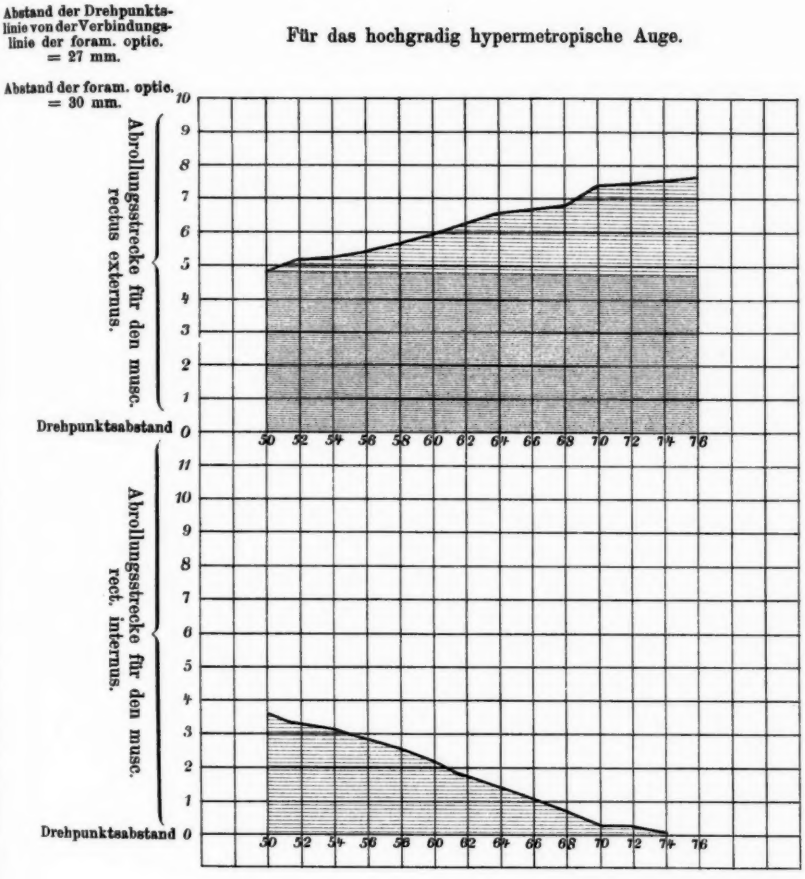
Abstand der Drehpunktslinie von der Verbindungslinie der foram. optic. = 27 mm.
Abstand der foram. optic. = 30 mm.
Abrollungsstrecke für den musc. rectus externus.
Drehpunktsabstand
Abrollungsstrecke für den musc. rect. internus.
Drehpunktsabstand
50 52 54 56 58 60 62 64 66 68 70 72 74 76

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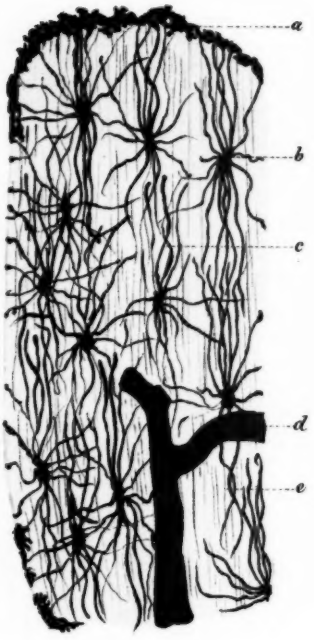
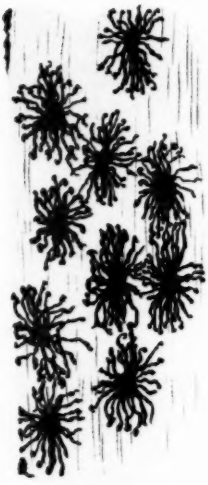
Fig. 1.



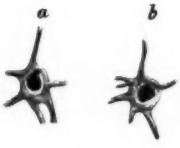
Spinnenzellen im Sehnerv des Menschen.

Fig. 2.



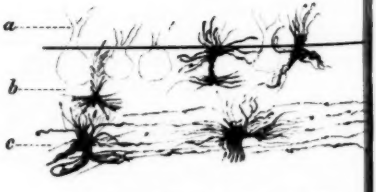
Spinnenzellen im Sehnerv des Sperlings.

Fig. 3.



Durch Zerzupfen
isolirte Neurogliazellen aus dem Sehnerv.

Fig. 4.



Spinnenzellen aus der Retina des Ochsen.

Dr Greeff ad. nat. delin.

Verlag von J

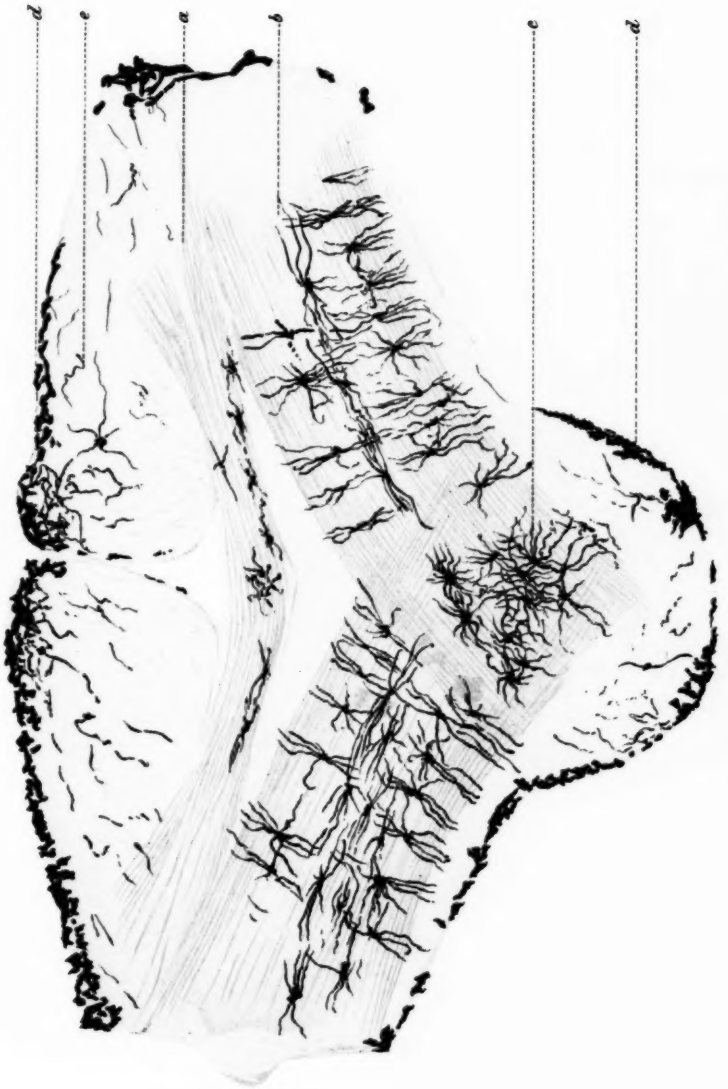


Fig. 5.

Schnitt durch das Chiasma nervorum opticorum der Taube.

Lith. Anst. v. C. Kirst, Leipzig.

Fig. 3.

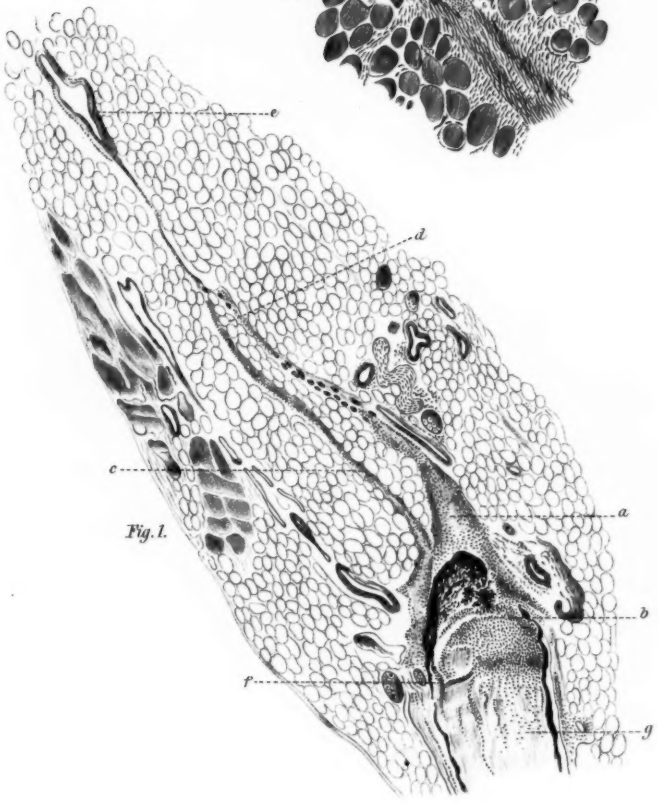
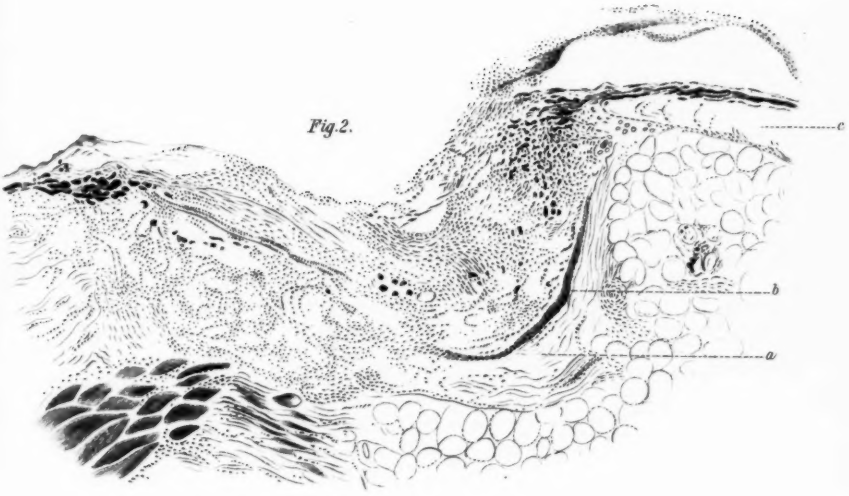


Fig. 1.

O. Peters, del.

Fig. 2.



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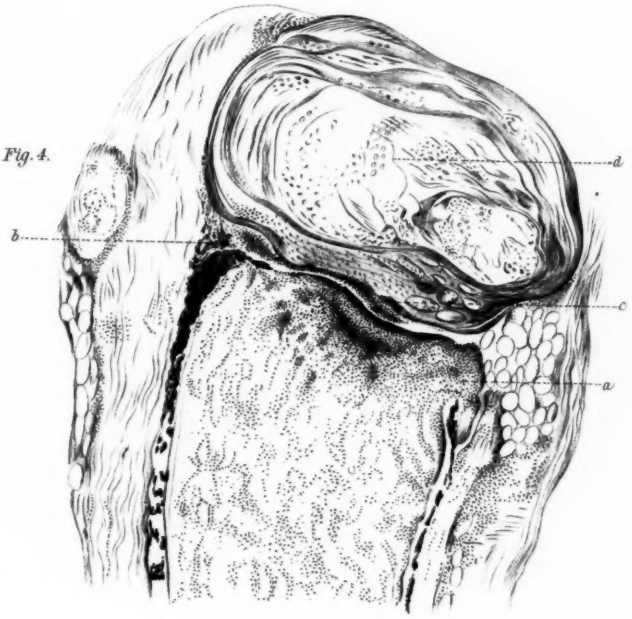

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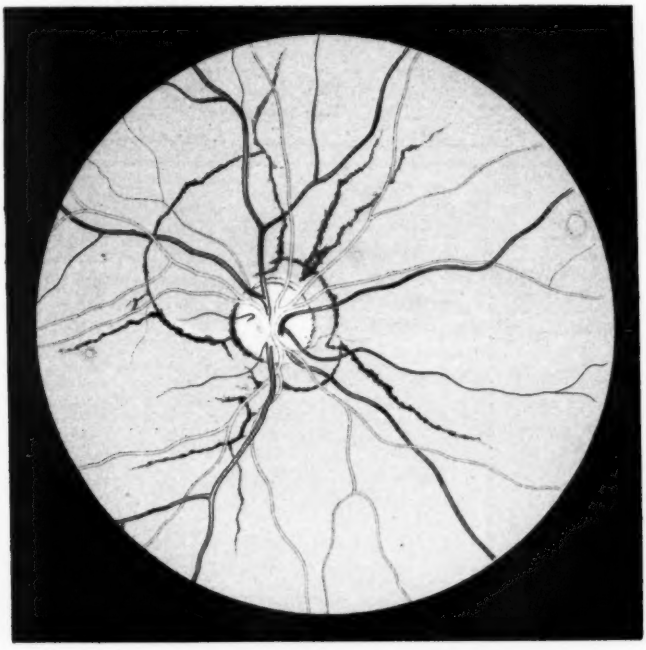

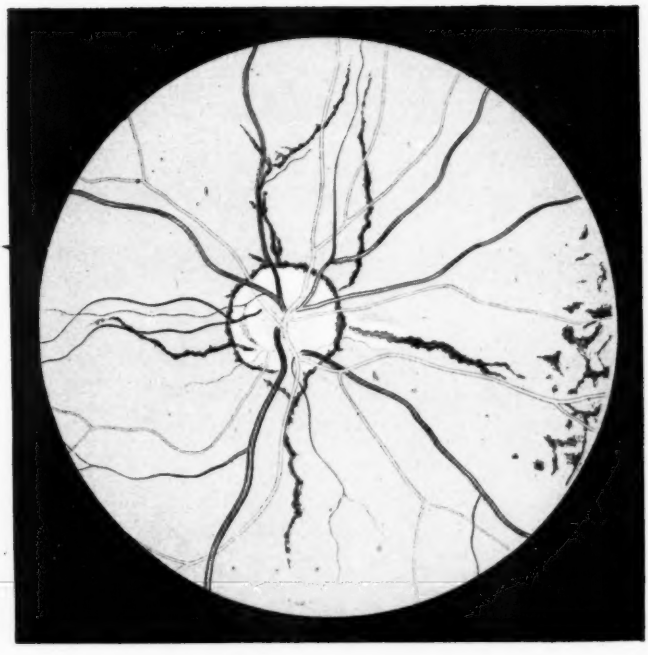

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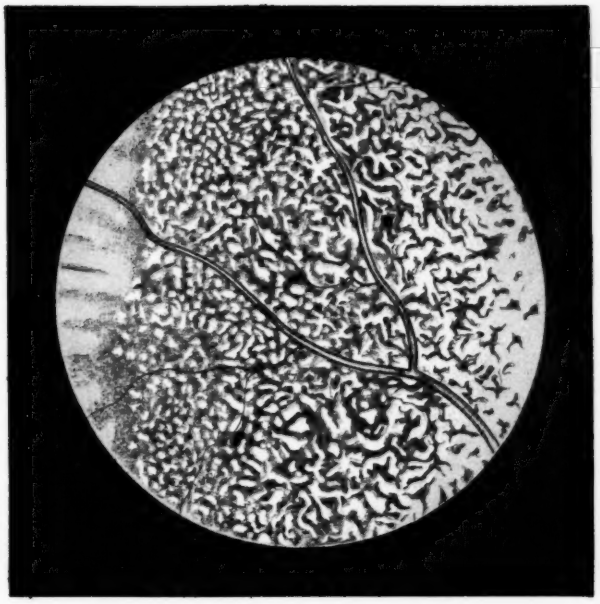

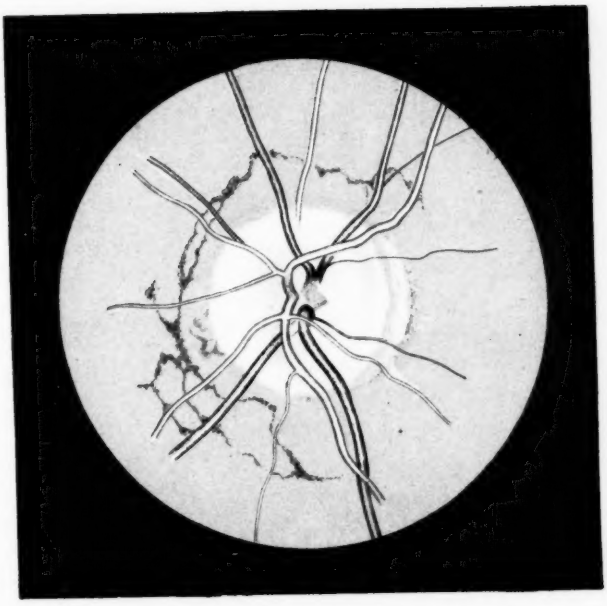

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B

C

a

D

Archives of Ophthalmology, Vol. XXV., No. 4, P. 456, etc.

Microphotograph of a section through the retina in a line passing through

The space included between the dotted lines (a a¹) indicates the area of distinct vision. One inch on the pho

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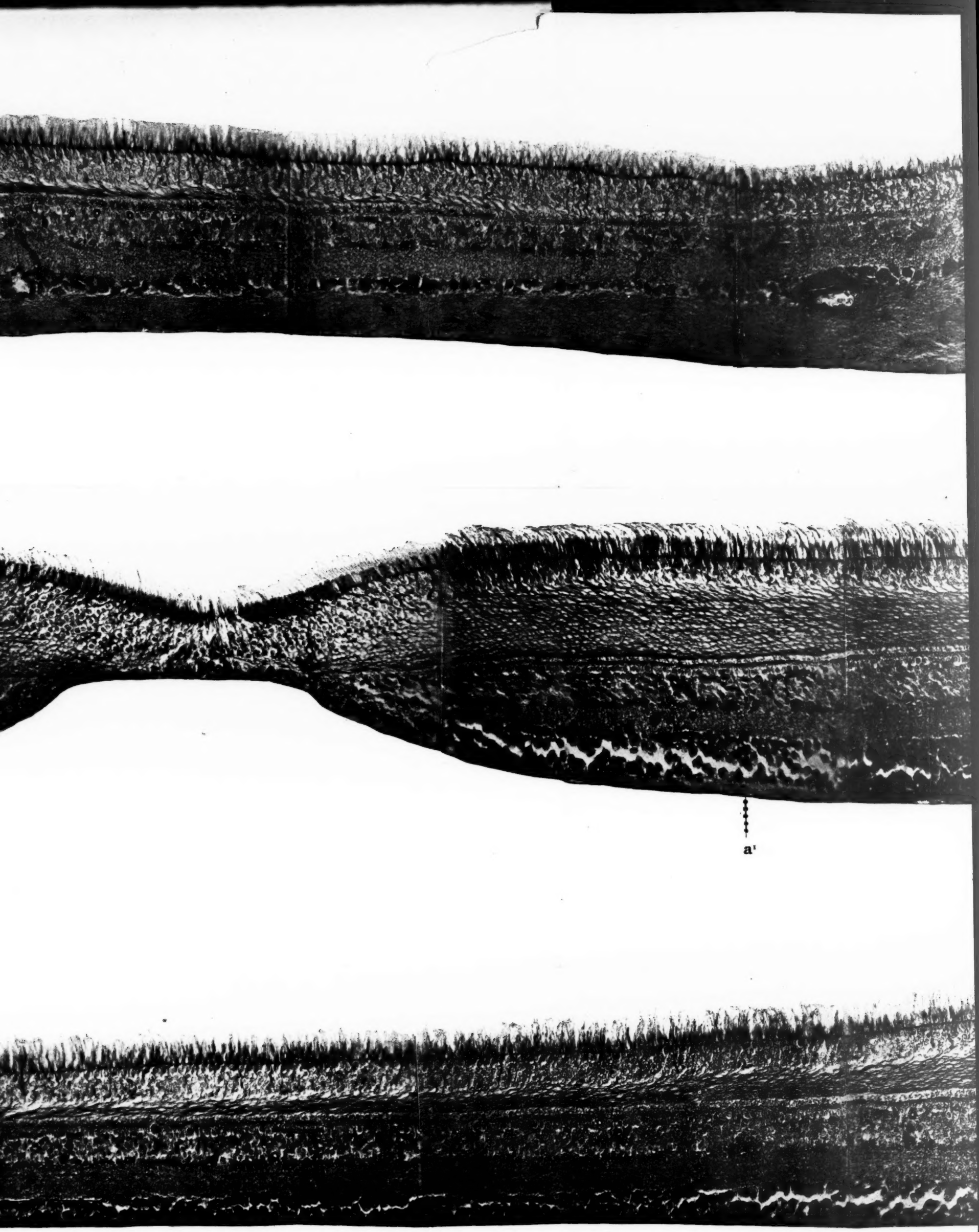
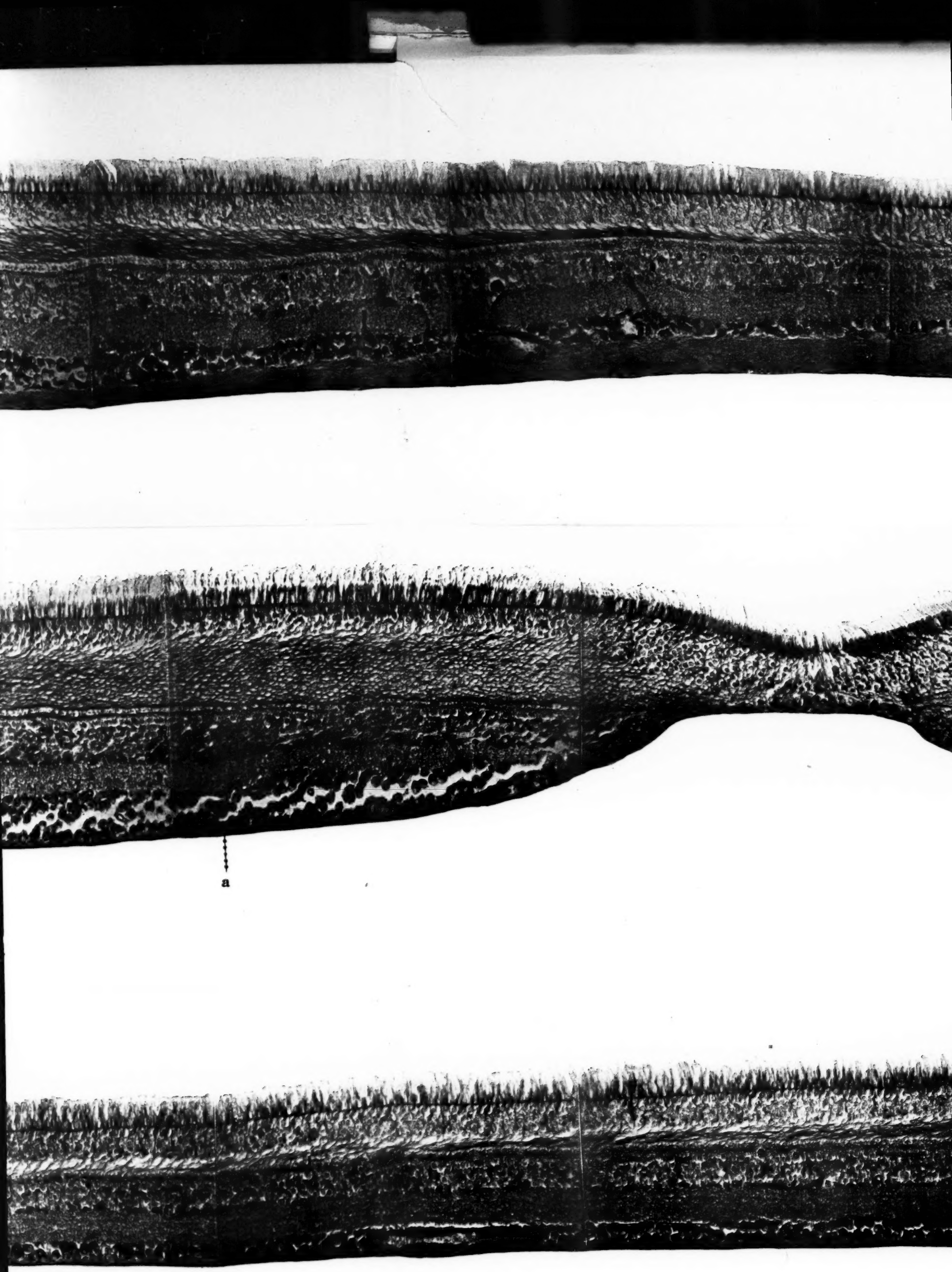


through the Disc and centre of the Fovea showing the Macula Plexus and Macula Plexus Border Layer × 250 diam.

the photograph = $\frac{1}{10}$mm on the specimen. The left hand edges of each piece of the microphotograph is continuous with the right hand edge of the piece underneath.



456, ETC.

Microphotograph of a section through the retina in a line passing through the Disc and centre of the Fovea sho

The space included between the dotted lines (a a¹) indicates the area of distinct vision. One inch on the photograph = $\frac{1}{10}$mm on the specimen. The left hand ed

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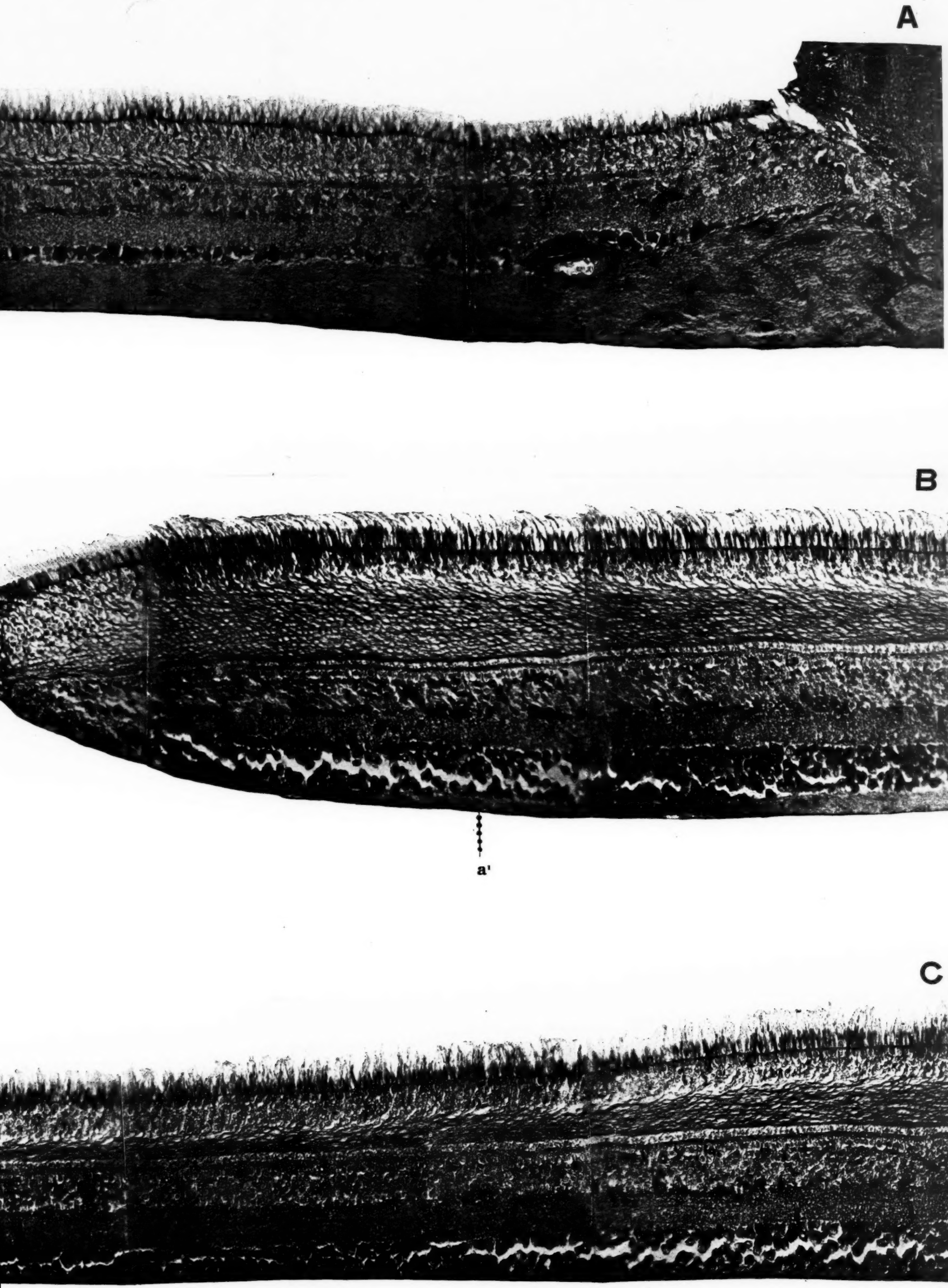

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a showing the Macula Plexus and Macula Plexus Border Layer × 250 diam.

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BY

DR. H. KNAPP
OF NEW YORK
AND
DR. C. SCHWEIGGER
OF BERLIN

DR. W. A. HOLDEN
OF NEW YORK
ASSISTANT EDITOR

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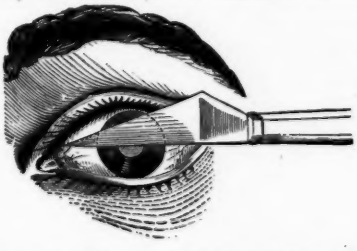

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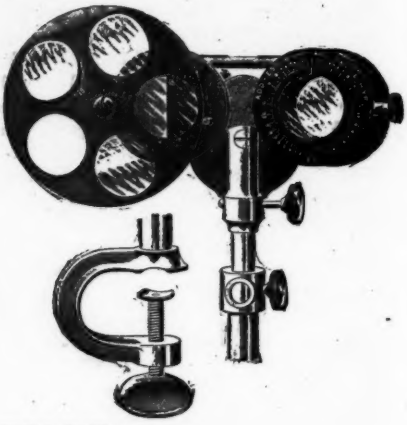

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